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COASTAL NAVIGATION;

OR

NOTES ON THE USE OF CHARTS.

BY

JOSEPH JAMES CURLING,

MISSIONARY PRIEST OF THE BAY OF ISLANDS, NEWFOUNDLAND; AND RURAL DEAN OF
THE STRAIT OF BELLE ISLE;
HOLDER OF A BOARD OF TRADE "CERTIFICATE AS MASTER OF HIS OWN PLEASURE YACHT," [illegible]
AND FORMERLY A LIEUTENANT IN THE CORPS OF ROYAL ENGINEERS.

WITH DIAGRAMS AND A CHART TO ILLUSTRATE THE NOTES.

[illegible]

PORTSMOUTH:
GRIFFIN AND CO., 2, THE HARD
[illegible]
LONDON: [illegible]—SIMPKIN, MARSHALL AND CO.

Price 2s. 6d.

NOTE.

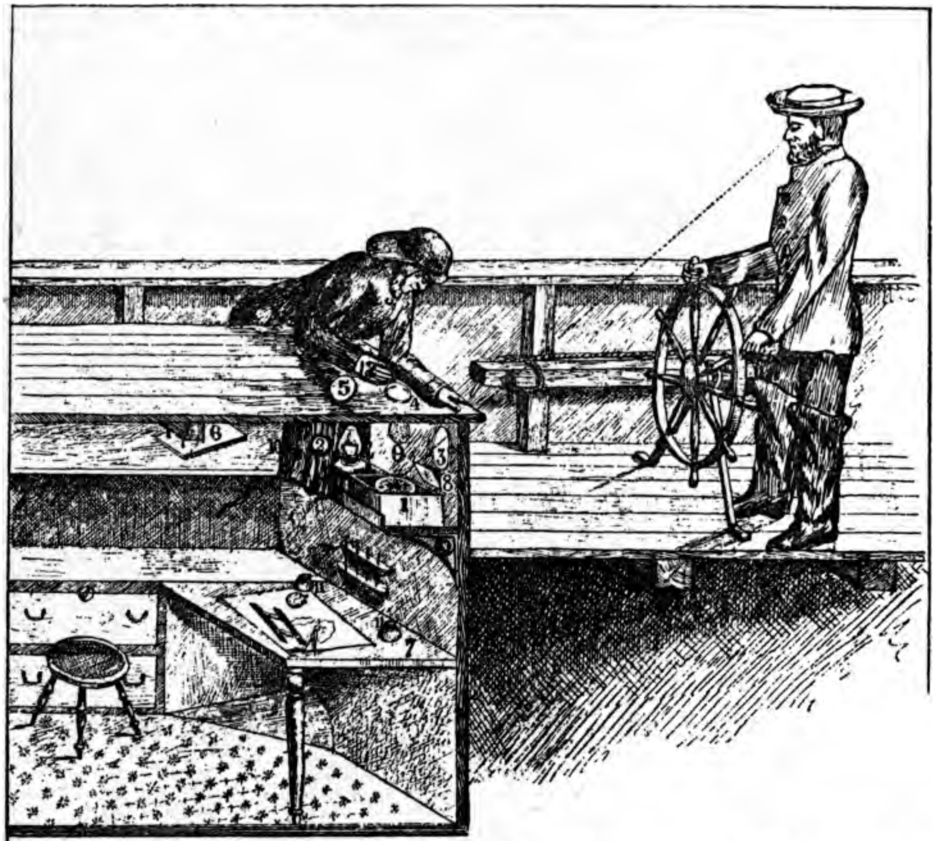
In working out the examples given in this book the following articles are required, viz.: one pair of 18-in. parallel rulers, one pair of dividers or compasses, another pair with a socket for a pencil in one leg (those made of nickel with steel points are the best), one H or HH pencil, and a piece of india-rubber.

In unfolding the chart in this pocket notice the creases, so that you may be able to fold it up again as it was folded at first. Should you not wish to fold it again you can mount it as follows (but you cannot fold it after it has been mounted; then, however, you can roll it):—

Stretch a piece of brown holland, or similar material, about an inch larger all round than the chart, by tacking it down upon as even a wooden surface as you can find. A deal table will answer the purpose, and the tacks should not be more than 4 inches apart. Prepare half a cupful of stiff but smooth flour paste, thoroughly wet the holland with water, then cover it all over with paste. Now damp the back of the chart and lay it on the holland as evenly as possible. With a sponge or pad of soft rag or tow press down the chart, commencing from the middle and working towards the sides. Take care not to stretch the chart unevenly, as you are liable to do by pressing too hard. Leave it in a dry place for twenty-four hours, then take out the tacks, cut off the holland, leaving an edge of half inch all round; rub a little paste on this edge and turn it down on the margin of the chart. Give time to dry, and your chart will be strongly mounted.

600050122G

North Foreland Light bears S.S.W., Sir!



Cabin of the Master of a Coasting Vessel, 100 Tons register, with Port side of Cabin removed so as to show the Binnacle and Chart arrangements. See pages 13, 17, and 25.

1. Steering compass in box.
2. Binnacle lamp.
3. Port through which helmsman sees the compass; this opens to the left.
4. Light in deck, 3 in. diameter, placed exactly above centre of compass for taking bearings.
5. Brass cover for 4; it is shown turned back. (A piece of thick glass and wooden cover will answer very well for 4 and 5).
6. Reflector to throw light on chart table.
7. Chart table.
8. Reflector, by means of which the master, when at the chart table, can see the lubber line, thus making the steering compass a "tell-tale." (Common looking-glass will answer for the reflectors in 6 and 8.)
9. Ventilator to allow the escape of the heat from the lamp.
10. Sliding curtain to shut out light from cabin when required.
11. Chart weights.
12. Taking bearings.

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I Dedicate these Notes

TO

THE BELOVED MEMORY OF MY GRANDFATHER,

JAMES WILSON,

COMMANDER OF THE MISSIONARY VOYAGE TO THE SOUTH PACIFIC OCEAN
MADE IN THE LONDON MISSIONARY SOCIETY'S SHIP "DUFF,"
1796 — 1798.

PREFACE.

THE following pages have been written to help the unlearned in making use of charts for Coastal navigation.

The gist of their contents was first delivered as a lecture to fishermen at our Church Institute in this Bay. I wished to assist these men in their hazardous sea work, but I could not find any book simple enough to answer my purpose, and was forced to prepare my own notes. These notes are now published, after careful revision, in the hope that they may do something to remedy the want I then experienced. This forms my excuse for touching upon ground which I should have thought was already more than fully occupied.

My thanks are due to the Rev. J. F. Phelps, Head Master of the Church of England Academy, St. John's, N.F., who has had much experience and success in elementary teaching, for the examination of these notes.

Corrections of mistakes or suggestions for the improvement of this book will be gratefully received by the publishers or myself, in case a second edition should be at any time required.

Should it happen that any profit accrues to me from the publication of this book, it will be given towards the completion of the cathedral church of St. John the Baptist, St. John's, N.F., which is being undertaken as a memorial to the late Bishop Feild, D.D., Bishop of Newfoundland from 1844 to 1876, who has been so happily described as the "hardy apostle of fishermen."

J. J. C.

BAY OF ISLANDS, NEWFOUNDLAND,
October, 1884.

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SEA LINEAR MEASURE.

6 feet = 1 fathom
100 fathoms = 1 cable
10 cables = 1 sea mile (nearly)
3 sea miles = 1 league
60 sea miles = 1 degree of latitude.

A sea mile or knot, sometimes termed a geographical mile, is assumed to contain 6080 feet.

COASTAL NAVIGATION.

Some of the more difficult words are explained at the end of each Chapter.

CHAPTER I.

On Charts generally and the Measurement of Distance.

TWO KINDS OF NAVIGATION.—Navigation may be said to consist of two kinds. Firstly, the Science of Navigation relating to voyages across oceans, far away from land, when, by means of Dead Reckoning, computed from Traverse Tables, &c., the ship's position is determined from day to day, and compared with her place as found by observation of heavenly bodies; and secondly, the Navigation of Coasts, or of the seas between neighbouring countries, when observations of the heavenly bodies are not made use of, and the Dead Reckoning is laid down on the chart from hour to hour, as the ship proceeds on her voyage, without reference to the Traverse Tables.

Aim of this Book.—The following pages are solely concerned with the latter kind of navigation, and it is hoped that the title "Coastal Navigation" will sufficiently describe their aim.

Object of Charts.—Charts are constructed to help people to navigate the sea, whilst maps are made to enable them to find their way about the land. In charts, therefore, most of the writing and figures is on the white part, which represents water, and the shaded part, without much writing, represents land. This, you will see, is just the reverse of the arrangement in maps.

Position of true North.—The top of charts is nearly always true North, so that the bottom will be South, the right-hand side East, and the left-hand side West. The first point you should ascertain concerning a chart is the direction of true North upon it, and I hope you will have no difficulty in telling this at a glance, when you have read this book.

Meridians.—The lines ruled across the chart from top to bottom are called Meridians, and are to show the distance East or West of a certain Meridian, which it is agreed to call Zero, and to make a starting-point from which to measure the distance to other Meridians. With Great Britain and America the Meridian thus marked Zero, or the First Meridian, as it is termed, passes through Greenwich, close to London. The distance of any place East or West of the Meridian of Greenwich measured on the Equator is called its Longitude. You will see the ends of these Meridians at the top and bottom of the chart are marked so many °, read "degrees." Each degree is divided into 60′, read "60 minutes," and each minute is divided into 60″, read "60 seconds."

Longitude.—Thus to find the Longitude of the Meridian passing through the Observation Spot at A on the chart, or shortly, to find the Longitude of A, draw the line marked "Mer. A," through A, and parallel to either of the Meridians marked 14° or 15°, and read it 14° 33′,—because each of the small divisions at the bottom of the chart is 5′, there being 12 of these divisions in 1°. You will see also that the Longitude is to the West of Greenwich, so that we say the Long. of A is 14° 33′ W. We cannot read the seconds, as the scale of the chart is too small for them to be marked.

Scale of Longitude no use for measuring Distance.—Now the length of each degree of Longitude is different for every Latitude, and continually varies, so that it is of no use for the measurement of distance. For example, at the top of our chart the length of 1°,—"one degree"—of Long. is 40 miles, and at the bottom it is 42 miles. It is very important to remember this.

Parallels of Latitude.—Distance is always measured on the Scale of Latitude at the sides of the chart, which are joined by lines running across the chart called parallels of Latitude. These lines mark the distance North or South of the Equator, which is a great circle round the earth at equal distances from the North and South Poles. From the Equator to either Pole there are 90° (90 degrees) of Latitude, which is called North or South Latitude, according to its position North or South of the Equator. In each degree of Latitude there are 60′ (60 minutes), and a minute of Latitude is everywhere equal to 1 sea mile, or 1 geographical mile as it is sometimes termed. A minute of Latitude is either divided into 60″ (60 seconds), or into tenths.

To find the Latitude of any place draw a line through it parallel to a line of Latitude, and read the Latitude where it cuts the graduated Meridian at the side of the chart. In this way a short line, marked "Lat. A," on the right hand side of the chart, has been drawn from the Observation spot at A parallel to the parallel of 47°. A is known to be in Lat. 46° 28′ 13″, but you cannot read the seconds from the large chart, as the side scale is too small, but you may guess that it is about $\frac{2}{10}$ths of a division distant from 28′, and write Lat. 46° 28′2 N.

Divisions of Sea Mile.—For our purposes in this book we shall find it more convenient to use the latter division of the mile, viz., tenths, and to divide the knot of the log-line also into tenths, so that the divisions of the sea mile and the knot may correspond with each other.

Length of Sea Mile.—The length of a minute of Latitude, or nautical mile, or knot is taken, as 6080 feet; it is reckoned to contain 10 cables, and a cable's length is assumed to be equal to 100 fathoms.

Mercator's Charts.—Charts are constructed upon Mercator's system, in which the Meridians are all drawn parallel to one another, and degrees of Latitude are represented by lengths gradually increasing as the Latitude is farther from the Equator, and nearer the Pole.

Measurement of Distance on Chart.—You will find, for example, in the chart accompanying this book, that from 48° to 49° Lat. is about 2′·5 longer than from 46° to 47° Lat. Hence we have the following rule: Always measure *distance* upon the graduated Meridian at either *side* of the chart, and carry your dividers to the top, middle, or bottom part of the scale, as the points between which you are measuring the distance are situated at the top, or middle, or bottom part of the chart.

To measure, for example, the distance from B to C, lay the edge of the parallel rulers against the places (the exact spot to measure from is shown thus, ×), then with your dividers measure half the distance; place the point of one leg at 48° 20′, this being opposite a point about midway between B and C; measure upwards and downwards and you will obtain 43 + 43·5 = 86·5 m., the distance required.

Or take 20 m. in the dividers at Lat. 48° 20′, and step this distance along the edge of the ruler commencing at either place, and at each step saying 20, 40, 60, 80 miles; then measure the remaining short distance with the dividers, and you will find 6·5 m. over, thus making the distance, as above, 86·5 m.

If the distance be too long for the parallel rulers to reach from one place to the other, as from E′ to D, stretch a piece of string between them, keeping the ends down by weights, and proceed as above, only instead of halving the distance you may divide it into four parts. You will thus find E D = 268 m.

If the distance to be measured is round corners, it is best to connect the places, between which the distance is to be ascertained, by pencil lines, and to measure each line separately and add them all together.

Plans of Harbours.—The space in the left hand bottom corner of the chart divided from the rest of the chart by a thick line, is a plan of a harbour, and is drawn upon a larger scale than the main part of the chart. In this plan there is a special scale of miles and cables, and one mile is represented by 2 inches instead of about $\frac{1}{10}$th of an inch, as it is on the large chart. The plan is constructed upon this large scale in order that every detail may be marked, and the nature of the channel readily understood by a ship entering or leaving the port. The anchorage can be chosen by bearings of the various marks indicated. There is also a scale of Longitude, and the position of a Point of Observation is given; these being required when rating chronometers. The soundings are in feet instead of fathoms.

Dividers.—The dividers mentioned above are sometimes called compasses; the joint should not be too stiff, or it is difficult to set them to the distance required, nor should it be too easy or you may lose the distance you have taken off before it is measured. Allow the points to rest lightly on the chart without driving them in; should you require to make a mark on the chart, do so with a fine-pointed F or H pencil, like this, ×, making the lines cross at the point you wish to mark.

Marking Ship's Position.—To identify the mark you thus make, it is often useful to add the hour and date thus, $\times\ {}^{3}\overset{\text{p.m.}}{{}_{18|2}}$, which means that you were at the position indicated at 3 in the afternoon of the 18th February.

Care of Charts.—If you can manage not to roll your chart, but to keep it flat in a portfolio, or between boards, you will find the chart much easier to work upon with your parallel rulers and dividers, than if you roll it. For this flat use the Admiralty charts are the most convenient, and they can be obtained very cheaply, or if you have one of the long large charts supplied by mercantile marine booksellers, provide yourself with four flat lead weights, about 1 lb. each, covered with wash-leather, to keep your chart open, see No. 11, frontispiece.

Measurement of Distance at Sea.—Distance at sea is measured by means of a Patent Log, or by a log-line and log-ship with a 14 sec. or 28 sec. sand-glass, or by a watch with a seconds hand.

Patent Log.—A patent log is towed continually from the quarter with line enough to clear the eddies in the ship's wake; it consists of a rotator, to which vanes are attached to make it rotate, as it is towed through the water; these vanes are fitted at such an angle with the axis of the rotator that the revolutions made by the log in passing through a certain distance correspond with the distance registered by three dials contained in the log itself. These dials measure tenths, units, and tens of miles respectively, up to 100 miles.

Common Log.—The common log consists of a flat piece of wood called the log-ship, made in the shape of a quadrant, the circular edge being loaded with sufficient lead to make it float upright in the water; one side of the quadrant should be about 6 in. long. The log-line is attached to the log-ship by three legs of line, each 3 ft. long, so that the log-ship may offer a little resistance and so keep its position in the water. One of these legs is fastened to the log-ship by a bone peg, that readily comes out through the pressure of the water against the log-ship, when it is hauled in board after the rate of sailing has been determined. When used, the log, and some portion of the line known as the "stray-line" is thrown over the stern, the log soon losing the impetus of the vessel, remains stationary in the water, and the line is permitted to run out freely as the ship sails onward for an interval of time marked by the sand-glass.

Log-line.—In order to measure the ship's rate of sailing in sea miles per hour, the length of a knot on the log-line must bear the same proportion to a sea mile, that the seconds of the sand-glass bear to an hour.

Now in 1 hour there are 3600 sec. And in one sea mile there are 6080 feet; therefore to calculate the length of a knot on the log-line:

$$3600 \text{ sec.} : 28 \text{ sec.} :: 6080 \text{ ft.} : \text{required length} = 47{\cdot}3 \text{ feet.}$$

If a 14 sec. glass be employed, the number of knots read from a log-line constructed with knots of 47·3 ft. each must be doubled.

The log-line is marked with a piece of bunting at the end of the stray line, which should be 12 fathoms long.

One knot at every half knot.

A piece of leather at the first knot.

Two knots at two knots.

Three knots at three knots, and so on.

The log-line should be wetted before being marked, and the lengths of each knot frequently measured to insure the constant correctness of the log-line; it is wound on a reel, from which it can be readily paid out without checks. The tenths of a knot can be easily reckoned by hand, when the log is hauled in.

Decimals, Angles, and the Shape of the Earth.—There are three points that I will now endeavour shortly to explain, and although it is not necessary that you should at once master the third, it will assist you in understanding the subject of this book, whenever you can do so; they are, 1stly, decimals; 2ndly, angles, and 3rdly, the shape of the earth.

Firstly, Decimals.—I said above that a sea-mile is often divided into tenths, called cables, just as a dollar is divided into 10 dimes, or 10 cent pieces, or a dime into 10 cents. Now $5\frac{6}{10}$ miles is written in decimals 5·6 miles, and the dot between the 5 and 6 is called the decimal point.

In adding or subtracting numbers thus written, which are called decimals, always place the decimal points immediately beneath one another, and if there is no figure after the · you can always supply ciphers or 0's to the right of the point, without altering its value; thus in the last example of subtraction a cipher is added after 14.

Ex. Add together 2·5, 6·7, 210.

2·5
6·7
210·
Ans. 219·2

Ex. Subtract 6·4 from 12·2, also 2·5 from 14.

12·2 14·0
6·4 2·5
Ans. 5·8 Ans. 11·5

In multiplying decimals, multiply as if there were no decimal points, and in the result point off from the right as many decimals as there are in the two numbers multiplied together.

Ex. Multiply 13·50 by 2·5.

$$\begin{array}{rr} & 13\cdot50 \\ & 2\cdot5 \\ \cline{2-2} & 6750 \\ & 2700 \\ \cline{2-2} \text{Ans.} & \underline{\underline{33\cdot750}} \end{array}$$

In dividing decimals proceed as with common numbers, and in the result see that there are as many decimals in the quotient and the divisor together, as there are in the dividend.

Ex. Divide 161·5 by 5·1, also 7·68 by ·24.

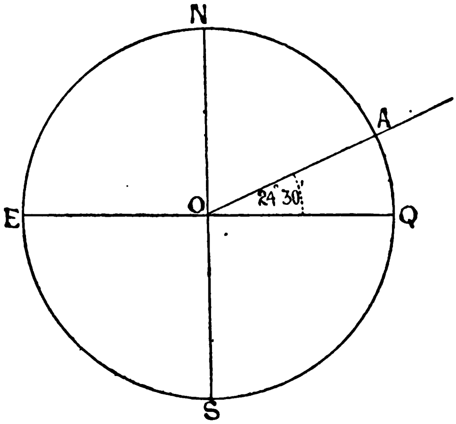
$$\begin{array}{l} 5\cdot1)\,161\cdot50(\,31\cdot6 = \text{Ans.} \\ 153 \\ \overline{85} \\ 51 \\ \overline{340} \\ 306 \\ \overline{34} \end{array} \qquad \begin{array}{l} \cdot24)\,7\cdot68(\,32\cdot = \text{Ans.} \\ 7\cdot2 \\ \overline{48} \\ \underline{\underline{48}} \end{array}$$

Secondly, Angles.—The inclination towards one another of two lines which meet is called the angle between them (see Fig. 1, on p. 8).

Thus A O Q is the angle made by the lines A O, Q O. In *naming* an angle, three letters are used, the *middle* letter being always the one which stands as the point where the two lines meet, and the other two letters being such as stand on some part of each of the lines forming the angle. Thus the angle formed by the two lines A O and Q O is called the angle A O Q, or the angle Q O A. It must not be called the angle O A Q or the angle A Q O. In the accompanying figure let O be the centre of a circle Q A N E S; O A, the radius; E Q, N S diameters; N E S Q A the circumference of the circle. This circumference is divided into 4 equal parts called "quadrants," by the lines

N S, E Q, each quadrant being subdivided into 90 equal parts called "degrees." Each of the angles Q O N, N O E, E O S, S O Q is called a right angle, and is said to be 90°, also N O is said to be perpendicular to E Q. The angle A O Q is said to be 24° 30′, because A Q, the part of the circumference between A and Q, contains 24½ of the 90 equal parts into which the quadrant Q A N is divided. A Q is called an *arc* of a circle *subtending* the angle A O Q of 24° 30′. You will now remember that the measurements of latitude and longitude are marked as if they were angles. This is really the case, for both latitude and longitude are arcs of circles, and measure the angles those arcs subtend or are opposite to, at the centre of the earth. This is sometimes called "Angular Measurement."

Fig. 1

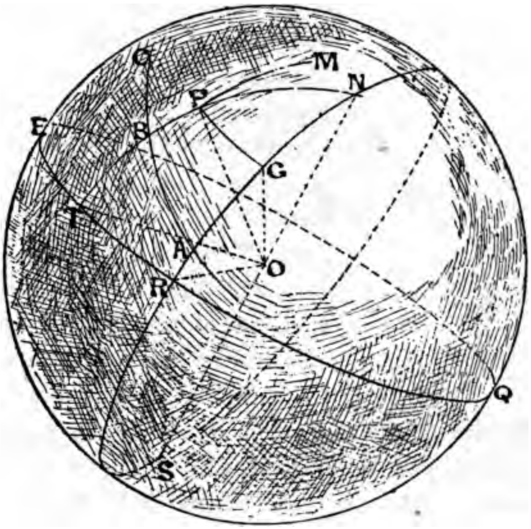


Thirdly, the Shape of the Earth.—The shape of the earth is like a ball or sphere, only it is slightly flattened at each pole like an orange. In the accompanying figure of an orange therefore please suppose the point N where the stalk is broken off to represent the North Pole, and the other end of the stalk (or core as it is called inside the orange) S, to represent the South Pole.

Let O be the centre of the orange, and represent the centre of the earth, then N O S the core of the orange will represent the axis of the earth, the North end of which always points towards the Pole Star.

Let E R Q be the equator, or such a circle as you would obtain by cutting the orange right across the core into two halves. The edge of either of the halves thus obtained may be considered a *great circle*, because the centre of the orange is the centre of the circle formed by these edges. Or if you cut the orange in any direction into *two equal halves* you must cut through the centre of the orange, and obtain a great circle. If, however, you divide the orange into *two unequal portions* you will not cut through the centre of the orange, and you will obtain at the edges two *circles*, which in such case are called *small* circles, because they are always less than a *great* circle of the same orange or sphere.

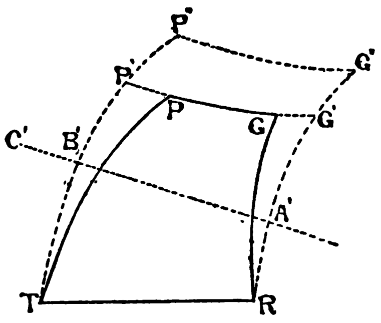
Fig. 2.



Let N G R S be part of a great circle passing through Greenwich, and the North and South Poles, also let N P T be part of another great circle passing through the North Pole, and any place P on the earth. Join T O and O R. Then N G R S is the meridian of Greenwich, N P T is the meridian of the place P, and the longitude of P west of Greenwich, is measured by the arc T R of the equator subtending the angle T O R at the centre of the earth. Let us suppose the angle T O R to be = 15° 6′ 16″. Then P is said to be in long. 15° 6′ 16″ W. Join P O and G O. Then the angle P O T, or the arc of the meridian T P, is the latitude of P, and being on the north side of the equator is called N. Let us suppose P O T to be equal 51° 28′ 36″, then P is said to be in lat. 51° 28′ 36″ N. This is also the lat. of Greenwich Observatory, so that T P and R G are equal.

Construction of Mercator's Charts illustrated.—Now peel off the skin of part of your orange lying between two meridians as T R G P, and let us see what is required to make this into a Mercator's Chart of that part of the earth. Your first difficulty will be that it won't lie down flat as a chart does, and in order to make it do so you will find that you want to stretch P G so as to make it equal to T R, or what is the same thing, you want to make the meridian T P parallel to the meridian R G, or generally, to make the meridians parallel, as you will remember they always are in Mercator's Charts. Let us suppose that you can do this, and that P′ G′ (read P dash, G dash), *see* Fig. 3, is made to equal T R by stretching P G sideways, or East and West. You will see now, however, that everything marked upon your peel, or chart as we will call it, is all stretched sideways, and is out of proportion. You require, therefore, to partly restore the proportion by stretching your chart T P′ G′ R in a Northerly direction, just in the same degree as you stretched it East and West; let us therefore stretch T P′ to P″, and R G′ to G″, so that P″ T and G″ R are respectively in the same proportion to P′ T and G′ R, as P′ G′ is to P G. This represents what is done in the construction of a Mercator's Chart. Now I hope you will in time be able to discover some clue to the real meaning of lines of Latitude and Longitude upon your chart, and to understand that each of these lines represents part of a circle.

Fig. 3.



If you can refer to a good Atlas with maps of the world showing it in two hemispheres, and also on Mercator's projection, carefully compare one with the other and it will help you to understand Mercator's system.

Rhumb Line.—I may here tell you that the curved line A B C drawn on

Fig. 2, making a constant angle with each Meridian it crosses, so that the angle N A C is equal to the angle N B C, A B C is called a rhumb line. In Fig. 2, A B C is really a spiral, but in Fig. 3, where T P G R has been formed into the Mercator's Chart T P″ G″ R, A B C, has become the straight line A′ B′ C′, the angle G″ A′ C′ being equal to the angle P″ B′ C′ by supposition, and P″ T parallel to G″ R. Hence it follows that the course of a ship sailing upon any one point of the compass is a straight line on Mercator's Chart.

Variation of Compass.—Also in the Fig. 2 let M be the Magnetic Pole towards which the needle at P points, join M P, then M P N is the Variation of the Compass at P, (see next Chap.).

Questions.—Where should you measure distance in Mercator's Chart?

What is the first thing to find out concerning a chart?

What is the distance from P to C? *Ans.* 192 m.

What is the distance from E′ to A, going outside N′ M? *Ans.* 167 m.

What is the distance from B to D? *Ans.* 208 m.

What is the width of the Harbour A, with 30 ft. of water, where large ships anchor? *Ans.* 3½ cables.

The following position of a new lighthouse was published by the Hydrographic Office, viz.: Lat. 48° 23′ N, Long. 11° 27′ W; mark it on the chart.

What is the Lat. and Long. of E′?

Explanation of Words and Signs.

Parallel.—When lines are throughout their whole length equally distant from each other, they are termed "parallel."

Graduated.—Divided into degrees.

Hydrographic.—Having to do with the formation of charts.

e.g., for example.

viz., namely.

+, add what follows this sign, which is read *plus*. −, subtract what follows this sign, which is read *minus*.

×, multiply by. =, equal to.

a : b :: c : d is read thus, "a bears the same proportion to b as c bears to d."

To join two points means to draw a straight line from one to the other.

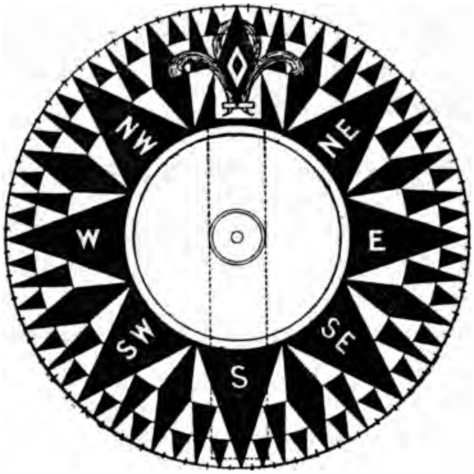
CHAPTER II.

THE MARINER'S COMPASS AND FINDING THE DIRECTION.

IN the last chapter I tried to show you how to measure *distance*, we have now to find the *direction*, which is ascertained at sea by means of the mariner's compass.

Compass Card.—The mariner's compass consists of a circular card (Fig. 4) which is carried by a magnetized bar of hardened steel placed under the line joining the North and South points. This magnetized bar is called the NEEDLE (shown by the dotted lines in the figure). This card is carefully poised upon a fine steel pivot rising from the bottom of a brass or copper bowl, by means of a small agate cup, fixed in the centre of the needle. The card and needle are thus free to swing, as if they were floating on water. The bowl containing the card is carried on gimbals, so that it may always remain level in whatever

Fig. 4.



direction the ship may pitch or roll. The bowl has a glass cover, and is placed in a wooden or brass case called the binnacle, which is fitted to carry lights to illuminate the compass at night (see frontispiece, Nos. 1 and 2).

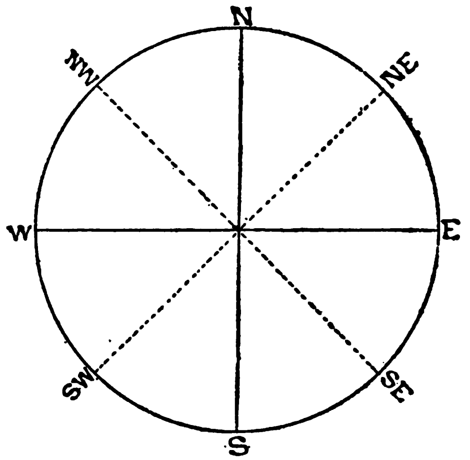
Lubber Line.—Inside the bowl is painted a vertical, or up and down line, commonly called the "lubber line," and the bowl is so arranged in the binnacle, that in small vessels the compass being placed directly over the keel, the centre of the compass card, the lubber line, and the ship's head, shall be in one line.

In taking command of a ship, one of the first duties of the captain should be to see that the lubber-line of the compass is exactly in a true fore and aft line.

Compass Course.—The helmsman steers by the lubber line, keeping any given point of the compass as near to it as possible; this point of the compass, by which the helmsman steers, is called the ship's compass course.

Points of the Compass.—The compass-card is divided into four quadrants by two diameters perpendicular to one another; the ends of these diameters are called North, South, East, West, and are marked N. S. E. W.; they are termed cardinal points. Each of these quadrants is divided into eight equal

Fig. 5.

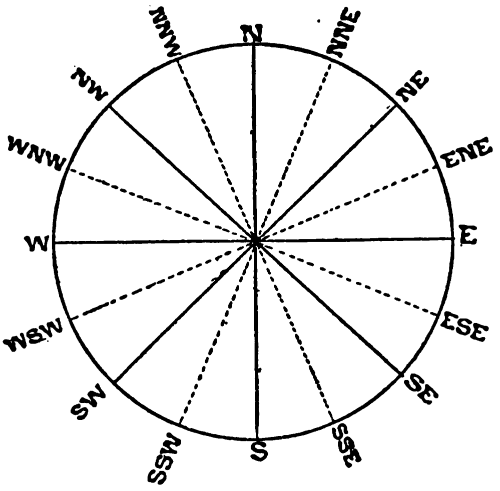


spaces, and the points dividing these spaces are called points of the compass; accordingly there are thirty-two points of the compass altogether.

The names of the points of the compass are obtained as follows: Starting with the two diameters NS, WE, divide the four quadrants equally by two more *dotted* diameters (fig. 5), and name their ends by the two letters between which each end falls, thus: N.E., S.E., S.W., N.W.

Now you have 8 spaces, as shown in fig. 6 by the firm lines; divide these spaces equally by 4 *dotted* diameters, and name their ends by the three letters between which each end falls, taking care always to place the single letter before the double letters; thus the eight new points are N.N.E., E.N.E., E.S.E., S.S.E., S.S.W., W.S.W., W.N.W., N.N.W. Now you have sixteen points, and please notice that the word "by" does not occur in any of them.

Fig. 6.

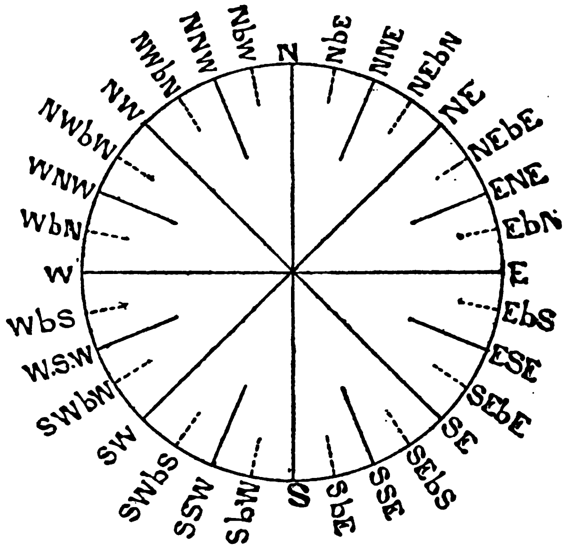


To form the remaining 16 points divide equally the 16 spaces we have already obtained by the short *dotted* lines, which are the ends of diameters (Fig. 7).

The word "by" (written b) means "one point towards," and is used in the formation of all the remaining 16 points; it is always followed by one of the names of the four cardinal points, N. S. E. W., and never by a double name, as N.E.

Starting from N. and moving in the direction of the hands of a watch, the first new point we come to is "one point" from N. towards E., it is therefore named N. b. E. The next new point we come to is "one point towards" N. before coming to N.E.; it is therefore named N.E. b. N. The next new point is one point towards E. from N.E.; it is therefore called N.E. b. E. There is one more new point before we come to E., it is "one point towards" N. from E., and is therefore named E. b. N. And so on with the other 3 quadrants of the compass.

Fig. 7.



Half and Quarter Points.—Besides the above 32 points, each point is divided into four quarters (see fig. 4, and compasses on the chart); the direction of the quarter, half, or three-quarters, being indicated from any of the 32 points towards one of the four cardinal points, e.g., N. ½ E. or N. ½ W. mean ½ point from N. towards E. or towards W. respectively. S.W. ¾ S. or

S.W. ¾ W. mean ¾ point from S.W. towards S., or W. But we do not say E. b. S. ½. E. because it is more simple to say E. ½ S., and it is the same thing.

The value of one point of the compass expressed in degrees is found by dividing the 90° contained in a quadrant by 8, the number of points which a quadrant contains; thus 1 point = 90° divided by 8 = 11° 15′, and ½ point = 11° 15′ divided by 2 = 5° 37′ 30″. You will find the following table useful for converting points of the compass into degrees, and *vice versâ*, and also for naming the half and quarter points.

TABLE FOR CONVERTING POINTS OF THE COMPASS INTO DEGREES, AND VICE VERSÂ.

N. to E.	N. to W.	Points.	°	′	″	Points.	S. to E.	S. to W.
North	North	0	0	0	0	0	South	South.
N. ¼ E.	N. ¼ W.	¼	2	48	45	¼	S. ¼ E.	S. ¼ W.
N. ½ E.	N. ½ W.	½	5	37	30	½	S. ½ E.	S. ½ W.
N. ¾ E.	N. ¾ W.	¾	8	26	15	¾	S. ¾ E.	S. ¾ W.
N. b. E.	N. b. W.	1	11	15	0	1	S. b. E	S. b. W.
N. b. E. ¼ E.	N. b. W. ¼ W.	1¼	14	3	45	1¼	S. b. E. ¼ E.	S. b. W. ¼ W.
N. b. E. ½ E.	N. b. W. ½ W.	1½	16	52	30	1½	S. b. E. ½ E.	S. b. W. ½ W.
N. b. E. ¾ E.	N. b. W. ¾ W.	1¾	19	41	15	1¾	S. b. E. ¾ E.	S. b. W. ¾ W.
N.N.E.	N.N.W.	2	22	30	0	2	S.S.E.	S.S.W.
N.N.E. ¼ E.	N.N.W. ¼ W.	2¼	25	18	45	2¼	S.S.E. ¼ E.	S.S.W. ¼ W.
N.N.E. ½ E.	N.N.W. ½ W.	2½	28	7	30	2½	S.S.E. ½ E.	S.S.W. ½ W.
N.N.E. ¾ E.	N.N.W. ¾ W.	2¾	30	56	15	2¾	S.S.E. ¾ E.	S.S.W. ¾ W.
N.E. b. N.	N.W. b N.	3	33	45	0	3	S.E. b. S.	S.W. by S.
N.E. ¾ N.	N.W. ¾ N.	3¼	36	33	45	3¼	S.E. ¾ S.	S.W. ¾ S.
N.E. ½ N.	N.W. ½ N.	3½	39	22	30	3½	S.E. ½ S.	S.W. ½ S.
N.E. ¼ N.	N.W. ¼ N.	3¾	42	11	15	3¾	S.E. ¼ S.	S.W. ¼ S.
N.E.	N.W.	4	45	0	0	4	S.E.	S.W.
N.E. ¼ E.	N.W. ¼ W.	4¼	47	48	45	4¼	S.E. ¼ E.	S.W. ¼ W.
N.E. ½ E.	N.W. ½ W.	4½	50	37	30	4½	S.E. ½ E.	S.W. ½ W.
N.E. ¾ E.	N.W. ¾ W.	4¾	53	26	15	4¾	S.E. ¾ E.	S.W. ¾ W.
N.E. b. E.	N.W. b. W.	5	56	15	0	5	S.E. b. E.	S.W. b. W.
N.E. b. E. ¼ E.	N.W. b. W. ¼ W.	5¼	59	3	45	5¼	S.E.b.E.¼E.	S.W.b.W.¼W.
N.E. b. E. ½ E.	N.W. b. W. ½ W.	5½	61	52	30	5½	S.E.b.E.½E.	S.W.b.W.½W.
N.E. b. E. ¾ E.	N.W. b. W. ¾ W.	5¾	64	41	15	5¾	S.E.b.E.¾E.	S.W.b.W.¾W.
E.N.E.	W.N.W.	6	67	30	0	6	E.S.E.	W.S.W.
E. b. N. ¾ N.	W. b. N. ¾ N.	6¼	70	18	45	6¼	E. b. S. ¾ S.	W. b. S. ¾ S.
E. b. N. ½ N.	W. b. N. ½ N.	6½	73	7	30	6½	E. b. S. ½ S.	W. b. S. ½ S.
E. b. N. ¼ N.	W. b. N. ¼ N.	6¾	75	56	15	6¾	E. b. S. ¼ S.	W. b. S. ¼ S.
E. b. N.	W. b. N.	7	78	45	0	7	E. b. S.	W. b. S.
E. ¾ N.	W. ¾ N.	7¼	81	33	45	7¼	E. ¾ S.	W. ¾ S.
E. ½ N.	W. ½ N.	7½	84	22	30	7½	E. ½ S.	W. ½ S.
E. ¼ N	W. ¼ N.	7¾	87	11	15	7¾	E. ¼ S.	W. ¼ S.
East	West	8	90	0	0	8	East	West.

Variation.—The North Point of the compass is usually marked by a *fleur-de-lis* (see fig. 4, and the chart); it always points to the Magnetic North Pole of the earth (marked M Fig. 2). This direction of the needle, represented by P M, at any place P (Fig. 2) on the earth, is called the Magnetic Meridian, and the angle M P N between this Meridian and the Geographical or True Meridian P N, is termed the Variation of the Compass. In some parts of the earth this variation lies to the East of the True Meridian, in other parts to the West, and it is named accordingly, Easterly or Westerly Variation; moreover, it varies slightly from year to year, increasing or decreasing from 1′ to 8′; the amount of this increase or decrease is stated on the chart, but it will not exceed a quarter of a point until the chart is twenty years old.

You will see, however, by comparing the variations of the several compasses on the chart, that the amount of variation changes considerably from place to place, so that in the 250 miles over which the chart extends there is a difference of 7°, or more than ½ a point.

Taking Bearings.—In making use of the compass to obtain the direction in which any object lies with regard to you, or, as it is called, its *bearing,* you must imagine yourself looking at the object from the centre of the card; then the point of the compass lying immediately between you and the object will be its bearing. In order thus practically to take the bearing of any object, such as a point of land, a lighthouse, the sun, or a star, place yourself on board so that the compass is between you and the object; then, holding your hand out straight, with the fingers pressed together (*see* frontispiece, No. 12), and the palm towards one side, point to the object and swing your hand up and down between the centre of the compass card and the object; wherever this swing of your hand cuts the edge of the compass card furthest from you, and nearest to the object, is the bearing of that object. This operation is termed "cutting down" an object, or "taking a hand bearing," and requires practice, but two persons accustomed thus to take bearings will not vary a quarter of a point.

Compasses on the Chart.—The compass cards on the chart are so arranged that the magnetic North Point, which is marked, as on the real compass cards, by a *fleur-de-lis,* is properly placed with regard to the true North, which is marked by a star, so as to represent the variation of the compass at that part of the earth, and to correspond with the compass on board ship, when at that spot. The points of the compass are not marked by letters on these chart compasses, because they would interfere with other marks on the chart; you must therefore thoroughly accustom yourself to read the compass without them.

Laying down Bearings on Chart and use of Parallel Rulers.—I will now show you how to lay down bearings on the chart. Suppose yourself in a ship at the point A, in the centre of the compass card in the right hand lower corner of the chart, and wishing to find how the light at point P should bear, lay the bevelled edge of the parallel rulers against P and A, and the point where the edge cuts the circle of the compass card is the bearing; in this case it is N. W. [illegible] W.

Examples.—Again, suppose your ship at D; to find the bearing of P, lay the edge of the parallel rulers against P and D, as shown by the dotted chart line; press down firmly the part of the ruler farthest from you, and move the part nearest to you until the rulers are fully opened, then press down the part you last moved, and slide the first-named part towards you, until you can bring one of the edges of the rulers into the position of the second dotted line II, passing through the centre of the compass. Now read the point where this line cuts the edge of the compass, and you have the bearing of P from D, W. N. W. nearly.

It is sometimes called W. N. W. [illegible] westerly, because it is [illegible] quite so much as W. N. W.; but I do not recommend the use of W. [illegible] It is better to name the point by that to which it seems to you nearest, as this cannot be steered more accurately than within a quarter of a point. You will see at once that the bearing of D from P is the opposite of W. N. W., viz., E. S. E.

Again, if you are at S and steering a E. E. course, which you wish [illegible] down on the chart, place the edge of the parallel rulers against the c[illegible] the compass and the S.E. point, then [illegible] draw a parallel line through [illegible] which you are steering [illegible] matter which edge [illegible] parallel, only [illegible]

[illegible]

I will only here refer to one or two ways in which you can prove your compass at almost any time. The principle upon which you do this is to observe the bearing of some object or objects, which is accurately known from the chart or from their positions in the heavens, and then compare the bearing you have observed by your compass with that which the chart shows. For example, if you are lying in a harbour like A you can often find two conspicuous objects as the windmill and beacon that are seen in line from where you are anchored; or having laid down the position of your anchorage by crossbearings of marks on the land (which you will learn how to do from the next chapter), you can take the bearing of some distant object, as one of the sides of the entrance to the harbour; or in sailing along a coast from headland to headland you will observe the course you steer, and compare it with that shown by the chart; or you may pass the line of two objects, whose bearing from each other is known, as the two lighthouses on Portland Head, South coast of England, or during any clear night you can take the bearing of the Pole Star, which should be the same within ⅛th of a point as the variation of the compass.

For example, lying in A harbour at anchor the beacon and windmill were observed to bear, when in line E. ½ N., which very nearly agrees with the correct bearing. Again, at sea at a the Pole Star was observed to bear N. b. E. ¾ E. From the table at p. 16, you will see that this point = 19° 41′ 15″; now the variation given on the chart is 19°, therefore the compass has only 41′ 15″ deviation, which may be disregarded.

Should you find by any of the foregoing methods that your compass bearings do not agree with those you know to be correct, your compass is said to have so many points or so many degrees deviation, according to the amount of the disagreement between your compass and the correct bearing.

The Pole Star.—The last-named method is so useful that every sailor who is in the Northern hemisphere should know how to recognize the Pole Star, the o[illegible] p in the northern hemisphere, that apparently never

day, but is always there in the same part of the

the other stars seem to go round the star as a

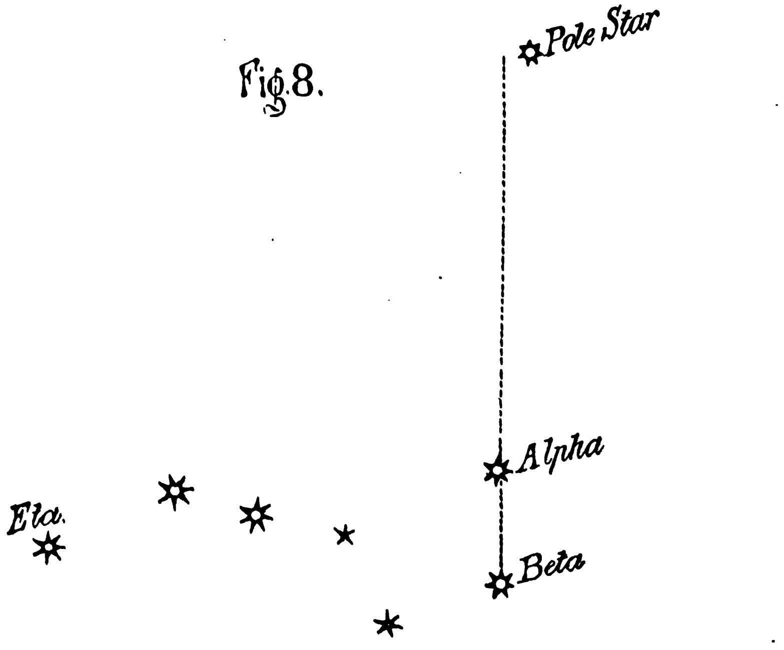
It is a group of 7 stars called the Great Bear.

the relative positions, and of the respective

1. 2

magnitudes shown in Fig. 8. From Eta to Beta the angular distance at our eye is 36°, and from Beta to the Pole Star 33°, or in both cases it is nearly the same as 3 points, if you were to turn the compass card up so as to point towards the stars. Alpha and Beta are called the pointers, because they point close to the Pole Star, which is not in itself a very bright star (although it is brighter than any other star that is at all near enough to be mistaken for it), so that these pointers are always used to distinguish the Pole Star. By turning this book "round the compass," with the Pole Star as a centre, you will see how the Great Bear appears at different hours of a long night.

Fig. 8.



Is it not a blessed thing that God has given us in this changeable world one point to look at, which appears to be always the same, although clouds and mists may hide it for a time, fit emblem of Him, Who changeth not! Please, therefore, be sure that you know the Pole Star.

Deviation how caused.—This deviation may arise from one or both of two causes: first, the magnetic axis of the needle may not exactly agree with the N. and S. line of the compass card, in which case you will find a deviation constant in amount, in whatever direction your ship's head may point; it is not difficult to allow for this until you get to harbour, where an optician will speedily set this right; or second, it may be due to the presence of some iron too near the compass, which would at once cause deviation.

In iron ships deviation cannot be avoided, and it is necessary to correct each course or bearing for it, but as this is rather difficult, and as vessels for coasting and fishing purposes are usually built of wood, I do not intend to explain the method of ascertaining and applying deviation.

In wooden vessels you must see that there is no iron within *four feet* of the compass, and there should not be any shelves or hooks, &c., near the binnacle, where iron might be carelessly placed.

A bulkhead between the compass and iron will not prevent the latter from affecting the needle; hammers, nails, marling spikes, bolts, iron-strapped blocks, hooks, wire rigging, are the kind of things likely to cause deviation. At any rate frequently test your compass, and explain to your crew how absolutely necessary it is to keep all iron away from it.

It is useful to remember that in a distance of 10 miles an error of ½ *point in the compass* will throw you *one* mile out in your reckoning.

I will conclude this chapter with six definitions, which it is well to remember in their exact words, as well as to be able to explain their meaning.*

True course of a ship is the angle her track makes with the true meridian.

Magnetic course is the angle a ship's track makes with the magnetic meridian.

Compass course is the angle a ship's track makes with the magnetic needle of the compass.

Variation of the compass is the angle through which the north point of the needle is drawn from the true north by the magnetism of the earth.

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* These definitions are taken from "The Seamanship and Navigation required for the Examinations of the Local Marine Board." By Captain R. Maxwell. London. J. D. Potter. Price 1*s*.

Deviation of the compass is the angle through which the north point of the needle is drawn from the magnetic north by the magnetism of the iron of the ship.

Total error of the compass is the angle through which the north point of the needle is drawn from the true north by the magnetism of the earth and the iron of the ship combined.

Questions.—1. Suppose yourself at the centre of the compass in the right hand top corner of the chart, give the bearings of *v*, *w*, *x*, *y*, *z*. *Ans.* *v*, N.W.; *w*, W. ½ S.; *x*, S.S.E.; *y*, S.E. ½ E.; *z*, E.b.N. ¼ N.

2. How does D bear from the mouth of A harbour? *Ans.* E.b.S. ¼ S.

3. At *c* how would you steer to pass South of M light ship? *Ans.* N.W. b. W ½ W.

4. Sailing along the coast from G to H with a fair wind, what would your course be? *Ans.* S.E. ¾ E.

5. Between E′ and P at sea, what should be the compass bearing of the Pole Star? *Ans.* N.N.E. ¼ E.

6. After sailing 50 miles from B to C, you find that the Pole Star bore by your compass N.E.b.N., where would you be with regard to the position you intended, supposing a fair wind and no current? *Ans.* 10 m. to the north-eastward.

Explanations of Words and Signs.

Vertical.—Up and down as the line of a plummet.

Magnitude.—Size.

Fleur-de-lis.—Flower of the lily.

Vice versâ.—The order being changed.

Gimbals.—The two brass rings by which the compass is carried in its box.

Hemisphere.—When a sphere is cut into two *equal* parts, each part is a *hemisphere.*

When one quantity is written over another, with a line between them, thus, $\frac{90^\circ}{8}$, it means that the *upper* one is to be divided by the *lower* one. Thus, $\frac{90^\circ}{8} = 11^\circ\ 15'$.

CHAPTER III.

FINDING THE SHIP'S POSITION BY CROSS-BEARINGS, &c., AND CONCERNING THE ARRANGEMENTS OF A BINNACLE.

IN the last chapter you learnt how to take bearings of objects from the ship, and to lay them down on the chart, also how to find from the chart the bearing of one place from another, and consequently the course a ship must steer in order to sail between the two places.

Cross Bearings.—You have now the power of ascertaining the ship's position, when you are in sight of land that you can recognise, and of laying it down on the chart by means of cross-bearings, as the following example will show you.

During a voyage from C to D the following bearings were observed: *

G bore N.N.W. ¼ W. H bore E.N.E. K bore N. b. E. ¼ E.

Draw lines from each of these places in the opposite directions to the bearings, viz., S.S.E. ¼ E. from G; W.S.W. from H; S. b. W. ¼ W. from K, and you will find that they meet in c. [The mouth of the brook H, and the figure 8 in the mountain K, are the exact spots.]

The Third Bearing.—Any two of these bearings would have given you your position at the point where they cut each other, but it is always best, if possible, to have a third bearing as a check upon the other two.

If, however, the three bearings do not meet in a point, but make a small triangle, which is not wider than $\frac{1}{20}$th of the distance from the nearest of the objects observed, you may assume the centre of the triangle to be about the ship's position; for example during the same voyage as above

Q bore E. b. N. ½ N. R bore E. b. S. G bore S.E. b. S.
—l may be taken as the ship's position.

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* The compass on the chart nearest C should be used, viz., that in the right hand bottom corner.

The value of a cross-bearing much depends upon the angle at which the bearings meet, which should neither be too acute nor too obtuse. Thus neither the cross-bearings of M and F, taken from d, are good, because the angle M d F is too obtuse, nor those of L and F taken from the same point because the angle L d F is too acute. As a rule, the angle between the bearings should not be less than 2 points, or greater than 14 points.

Bearing of Two known Objects in line.—If you can arrange for one of your bearings to be of two objects in line, that is, one being seen behind the other, whose positions are clearly marked on the chart, it is a great advantage, as you are really independent of your compass for this bearing.

Finding Position from Two Bearings of the same Object.—There is another way of determining the ship's position, when there is only one known object in view; this case frequently occurs when nearing or leaving the land. It is as follows:

Let the ship be off N.', and steering a N.W. course, it is required to find her distance from N.' Take a bearing of N.' before you are abreast it, if possible, let this bearing be S.W.; note the time, and see that the ship is carefully kept on the same course (N.W.), heave the log and let her rate be 10 knots. In an hour's time take another bearing of N'., and suppose it to be S. b. W.; heave the log again and let the rate be 8 knots, then if there is no tide running, you may assume the ship to have been going at the rate of 9 knots, and indeed to have run 9 miles, as the time elapsed since taking the first bearing is 1 hour. Lay down the two bearings N.E. and N. b. E. from N'.; the ship's position at the time of taking the second bearing must clearly be somewhere on the line of the bearing last taken. Measure 9 m. with your dividers, and place the parallel rulers in the direction of the ship's course, N.W.; keeping one part of the parallel rulers firm, move the other part until you can fit in the dividers so that the point of each leg rests on a bearing, and at the same time touches the edge of the parallel rulers.

The point e where the leg rests on the second bearing is the ship's position, for e. f. measuring 9 m. has been filled in between the two bearings, and lies in a N.W. direction.

Leeway and Current must be allowed for.—If the ship has been subject to leeway or current, or to both, during the time that elapses between taking the first and second bearing, you must correct the ship's course for these, as shown in the next chapter, before measuring the distance with the dividers, or laying down the course by the parallel rulers. In other respects the mode of procedure is the same.

Importance of Practice in Taking Bearings.—You will now understand the great importance of taking bearings accurately and quickly in any direction, and of laying them down correctly and rapidly on the chart; you should practise this in fine weather, when there is no difficulty in fixing your position, then you will have more confidence when it is rough, or during the night, when perhaps you can but get momentary glances at objects you know.

Suggestions for the Arrangement of a Binnacle.—A conveniently-arranged binnacle and chart-table are of great assistance in performing these operations; as these are not always provided, I have in the frontispiece sketched an arrangement of them, which has been found to work well in a small vessel. The binnacle is placed in a skylight, or cabin, where the lamp can be trimmed from below. The lamp burns kerosene or paraffin oil, and is provided with a glass chimney; it will be found to have the following advantages over an olive oil lamp. Firstly, the kerosene oil never freezes; secondly, it will burn all night without being trimmed; thirdly, it gives a sufficiently powerful light to illuminate the chart table by means of the reflector (6). *See* frontispiece.

By means of the reflector (8), the master, when at the chart table, can see the actual lubber-line by which the helmsman is steering; this is often a convenience and is more satisfactory than a separate " tell-tale " compass.

The small deck-light (4), immediately above the centre of the compass, enables bearings to be readily taken all round the horizon; it is protected from injury by the brass cap (5), which shuts over it, and prevents any glare coming through the light at night to those on deck.

The glass (3), through which the helmsman sees the compass, is made to open, and the reflections thus avoided, which sometimes make it difficult in the daytime to see the compass, especially when the sun is well aft.

The binnacle lamp can be arranged to throw light upon the clock and aneroid, which should always be found in the companion.

The colour of the painting of the interior of the binnacle should be so arranged as to reflect as much light as possible upon the compass, especially upon the lubber-line, and to throw as little light as possible towards the deck.

In a small vessel a binnacle thus fitted in a skylight or cabin is free from all chance of injury, whereas a binnacle placed by itself on deck may be capsized by a stray rope, or when reefing, or the light put out in stormy weather, just when it is most required.

A Word to Fishermen.—Some of my fishermen friends will say, I fear, that they cannot afford room for a chart table in their small vessels. Let me, however, suggest that the table can be made to turn up out of the way, and that the safety of his craft should come before every other consideration, also that "where there's a will there's a way." A little "will" expended in arranging for the navigation of his vessel will never be regretted.

Liquid Compass.—Before leaving the subject of the binnacle I may add how great a convenience a Liquid Compass is found to be for small vessels in rough water; its chief drawback is the expense, but at the same time the fact of one being supplied to each lifeboat stationed round the coasts of the United Kingdom is a guarantee of its utility.

Questions.

1. N′ bore N.N.W., M bore W.S.W.; what course must I steer for A Harbour? *Ans.* S.b.W., to clear the buoy off the 5-fathom patch.

2. V bore S. b. W. ¼ W., N′ bore S.S.E.; what course must I steer for S? *Ans.* W. b. N.

3. Steered from S′ a North course for 4 hours, running 8 knots, and observed W′ bore S.W., and E′ bore W. b. N. ¼ N.; how does this agree with my position? *Ans.* Very well.

4. Running W.S.W. past Q, I observed the light to bear South, and again after an interval of 2 hours it bore S.E.; there being no current or leeway, and distance run by log 15 m. How far was I from Q at the time of taking the second bearing? *Ans.* 19·2 m.

Explanation of Words.

Frontispiece.—A picture or plan placed on the first page of a book.

Liquid Compass.—A compass floating in liquid, which is usually a mixture of spirit of wine and water.

Barometer.—An instrument to measure the pressure of the atmosphere.

Aneroid.—A barometer, wherein the pressure of the atmosphere is measured without using quicksilver.

Acute—Sharp.—As the angle made by the legs of a pair of compasses when opened very slightly.

Obtuse—Blunt.—As the angle made by the legs of a pair of compasses when opened very widely, so as nearly to form one straight line.

CHAPTER IV.

LEEWAY AND CURRENTS.

IN Chaps. I. and II. you learnt how to measure the distance and lay down the direction in which you wished to sail, or in which you had already sailed. These would be sufficient to enable you at any time to find your position if it were not for the effect, 1stly, of leeway; 2ndly; of currents, which we will now consider.

Leeway.—Leeway is caused by the pressure of the wind and sea upon the side of the ship, and is always measured away from the wind or to leeward. Its quantity depends upon "the build and trim of the ship, the quantity and set of sail, closeness to the wind, velocity through the water, &c." The effect of leeway is to make the ship's true course through the water farther from the wind than is shown by the compass course.*

How Measured.—It is measured as so many points, or parts of a point. It is greatest when a ship is close hauled to the wind, and is under small canvas, and it disappears when the ship is running free, or before the wind.

Leeway can be measured when heaving the log, or towing a patent log astern, by observing how many points, or parts of a point, the log-line lies to windward of the line of the ship's keel. Sometimes a wooden quadrant, divided into quarter points is provided and fitted on the ship's taffrail, so that O C

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* "Sailor's Sea Book," p. 24. A most useful volume of Weale's Series, with an excellent chapter on the Law of Storms, which alone would make it well worth procuring. Price 2*s*. 6*d*.

(fig. 9) is in the same line with, or at any rate parallel to the keel. A guide for the line is provided at O. In Fig. 9 the ship is on the port tack, and there is 1½ pts. leeway.

For example, if the wind be N. and the ship's compass course be E.N.E. and 1 point leeway be observed, her true course will be E. by N. and we shall have to lay down E. by N. on the chart instead of E.N.E.

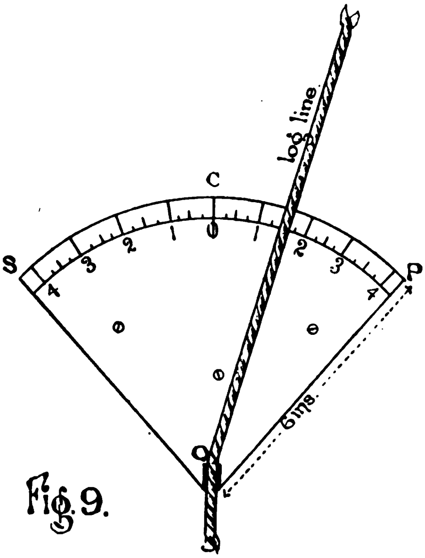

Fig. 9.

Currents, how Marked.—Currents, called "set," are bodies of water flowing in a certain direction, and are named according to the direction in which they move, thus a south-westerly current is one that carries you towards the S.W. It is marked on the chart by an arrow with two feathers, pointing in the direction towards which it sets, and the *drift,* or rate per hour, at which it moves, is marked in knots close to the arrow; thus in the middle of the strait at the right hand top corner of the chart, there is a south-westerly current, with a drift of 1 knot per hour so marked $\xrightarrow{\text{1 kn.}}$.

Tidal Streams, Flood and Ebb—Similar in some respects to currents are the flood and ebb streams, caused by the tides, except that they change their direction every 6 hours, nearly. The "set" and "drift" of a stream is described in the same way as that of a current, except that the flood tide stream is marked on the chart by an arrow feathered only on one side →, and the ebb tide stream by an arrow without feathers ←.

The tidal stream is spoken of as flood, when the water is rising, and as ebb, when the water is falling. And to enable the seaman to find out when this is the case, the time of high water at the full and change, that is to say, at full moon and new moon, is given at the most important places on a chart. It is marked H. W. F. and C., and is followed by the hour marked in Roman and the minutes marked in Arabic figures, thus VII. h. 50 m. For any particular spot this time of high water at the full and new moon may be considered practically constant.

Spring and Neap Tides.—The rise of spring tides, or those which occur near the full and change of the moon, also the rise of the neap tides, or those which occur near the 1st and 3rd quarters of the moon, are given in feet. Sometimes this information about the tides is given in a *table* on the chart instead of being placed at the various harbours, &c. Unless affected by strong and continuous gales of wind, the tidal streams run with greater velocity during the springs, than during the neap tides.

Tides are caused chiefly by the moon, and as the moon is about 50 min. later every 24 hrs. in coming over the same spot of the earth, the time of high water will be about 50 min. later every day.

Rough Way of finding Time of High Water.—You know, however, that it is generally high water twice every 24 hours, consequently each time of high water will be about half 50 minutes, that is to say about 25 minutes later than the preceding high water.

If, therefore, upon any particular day you know the number of days it is before or past the full moon or the new moon, and multiply 50 by this number, you will obtain the hours and minutes you have to subtract or add to the time of H. W. F. and C. to find about the time of high water upon such day.

If you have counted the number of days that it is *before* the full or new moon you must *subtract;* if you have counted the number of days that it is *past* the full or new moon you must add. You will of course count whichever way is nearest to a new or full moon.

The accompanying Table will help you in thus calculating the time of high water.

Before the New or Full Moon	Subtract
	hrs. min.
For 1 day	50
„ 2 „	1 40
„ 3 „	2 30
„ 4 „	3 20
„ 5 „	4 10
„ 6 „	5 0
„ 7 „	5 50*
but *after* the New or Full Moon	*add* the above times.

* *At Neap Tides* subtract 1 hour from the time of high water thus roughly treated.

You must also notice if the full or new moon from which you reckon occurs in the morning or afternoon, as the result you obtain will be for the morning or afternoon tide accordingly.

For example, the H. W. F. and C. at A is 11.45; at what time will it be H. W. on the 15th of February, 1884?

From any almanack you will find that in February 1884 it is full moon on the 11th of February, morning, and new moon on the 26th of February, afternoon. Now the 15th of February is four days after the full moon, therefore from the above table you must add 3 h. 20 m. to 11 h. 45 m., which gives 3 h. 5 m., afternoon, as the time of H. W. on the 15th.

Again, what time is it H. W. on the 23rd of February? Now the 23rd of February is three days before the new moon, therefore you must subtract 2 h. 30 m. from 11 h. 45 m., and the result, 9 h. 15 m., afternoon, is the time of H. W. on the 23rd of February.

I must warn you that these are only *rough* calculations: you may sometimes even be as much as 2 hrs. wrong, but generally you will be right within the hour. The greatest error in finding the time of H. W. by this rough rule occurs during neap tides, when it is of least importance, as the effect of tides is least; the additional rough rule, given above, of subtracting 1 hour from the time of H. W. at neap tides, will much diminish the error. Perhaps you will think that the rule is not worth having, if the results are so uncertain, but if you give it a trial I fancy you will often find it useful. The calculations for finding the *exact* time of high water are puzzling, and require tables that it is not probable you will have at hand.

Appearance of Moon, Waxing and Waning.—The following fact about the appearance of the moon may sometimes prove useful: When the moon looks like a D it is increasing or waxing; when it looks like a C it is decreasing or waning;* you can judge, by remembering this rule, the moon's age within a day, after you have accustomed yourself to observe its size at different ages.

Uses of Knowing time of High Water.—It is chiefly important to the seaman, for two reasons, to be able readily to ascertain the time of high water, 1stly, because the flood-tide stream may in some places begin to run at or about low water, and the ebb tide stream at or about high water. 2ndly, because many harbours are tidal, that is to say, there is only enough water in them to allow vessels to enter at certain times of tide, according to the draught of such vessels.

Currents and Tides affected by Winds and Locality.—Currents and tidal streams are always more or less influenced by prevailing winds, and every locality has its own peculiarity with regard to the tides; the tides of each port should be studied accordingly. As a general rule it may be taken for granted that close to the shore the tidal stream will turn earlier than it does in the offing. Upon this account I have given you rather a rough-and-ready way of finding the time of high water, as it is enough for you to know it within half an hour.

Current not shown by Log.—Having now shown you how to find out the set and drift of currents and tidal streams from the chart, we must consider their effect upon the ship's position.

Let me state to commence with that a current has no effect whatever upon the log when the ship is under way.

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* This rule has been expressed in the following Latin Hexameter:

"Decrescens crescit, crescens decrescere cœpit."

"Waning she waxes, and waxing beginneth to wane."

Many people seem to have an idea that the log will give them information about the current. This can only be the case when the ship is *anchored*, then the log thrown overboard will give the *drift*, and a bearing of the log-ship will give the *set* of the current. Indeed, the best way of finding out whether you are in a current when perhaps you are becalmed in a fog, is to lower a boat provided with a small anchor and long rope; even if you cannot get bottom at 100 fathoms there will not often be much current at that depth, and the boat will be sufficiently stationary to give you warning of the presence of any dangerous current.

Current Sailing.—The effect of a current or stream upon a ship is simply to carry the ship in the direction of such current or stream at whatever rate it is drifting. If, for example (*see* Fig. 10), a ship would sail from X^1 to X^2 in 1 hour, and this distance represents 2 miles, and she is in a current as shown by the arrow of 1 knot per hour, she will at the end of the hour be at X^3 instead of X^2, where X^2 X^3 is made equal to 1 knot. And the line X^1 X^3 will be the track the ship has really made through the water. To find therefore the effect of a current or stream upon a ship we have this rule. Lay down the ship's position as if there had been no current; calculate the drift of the current for the number of hours that the ship has been in it, then lay off this drift in the direction of the set of the current from the ship's last found position, as if it had been a distance and course sailed by the ship, and you will obtain her true place. It is very necessary to take care that the ship's course is so shaped that the current may not carry her into any danger, and this brings us to the further consideration how to direct a ship's course, if she has to sail in a current whose drift and set is known, towards a certain point. In order to answer this question it is necessary to assume the rate at which the ship will be able to sail, and this can usually be done with sufficient accuracy.

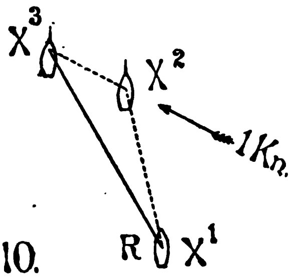

Fig. 10.

Let R^1 (*see* Fig. 11) be the place of departure, T be the point she is bound for, and let us suppose your ship will be able to sail 4 knots an hour

The set of the current is indicated by the arrow, and its drift is 1½ knots per hour. Join R^1 T by a straight line; this is the line you wish to sail on. From R^1 set off R^1 C equal to 1½ miles and parallel to the set of the current. Take your compasses, with a pencil in one leg, and take off 4 miles (the assumed rate at which your ship sails) and with the steel point of the compasses at C strike off part of a circle cutting R^1 T in R^3. Join C R^3, ascertain the direction of the line C R^3, and you will have the course you must steer from R^1 in order to keep on the line R^1 T. For draw R^1 R^2 parallel to C R^3, and R^3 R^2 parallel to C R^1, cutting one another in R^2, and you will find if you measure (or you may know from the properties of parallelograms, which is the name given to a figure like C R^1 R^2 R^3, whose opposite sides are parallel) that R^1 R^2 = C R^3 = 4 miles, and that R^2 R^3 is equal to R^1 C = to 1½ miles. Thus we have exactly the same conditions that we considered above in finding the ship's position, when her course, distance, and current, were all known; R^1 R^2 representing the ship's course and distance, R^2 R^3 the set and drift of the current, and R^1 R^3 the true track of the ship, as was required.

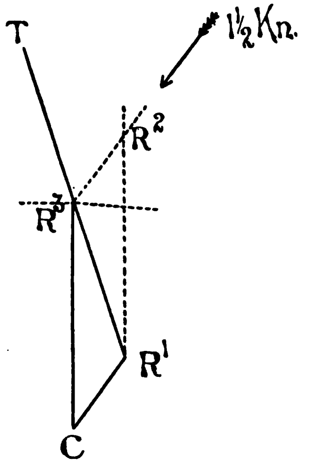

Fig. 11.

If you find these questions of ascertaining your position, when affected by currents, rather difficult at first, please do not give them up, and *guess* the effect of the currents instead of calculating it, for more ships are lost I believe through bad guesses being made than from any other cause.

One or two considerations may assist you in this matter. Firstly, if you are sailing for so many hours in the flood stream and then the same number of hours in the ebb stream, you may generally assume that one stream counteracts the other, and you need not calculate either, except to see that you are not carried by either stream into any danger. Secondly, if you are sailing in a current for a certain number of hours, perhaps beating to windward and making a number of courses, you need not calculate the effect of the current for each course (except as above, to see that you are not carried by it into any danger), but can reckon and lay down what this effect amounts to at the end of the supposed number of hours.

Examples.—Bound from C to B, supposing the tidal stream, slack, and the south-westerly current 1 knot per hour, your rate of sailing on a N. b. E. course 6 miles per hour; where will you be at the end of 12 hrs.? Set off C g, N. b. W., 72 miles (= 6 × 12) through g draw gg′ parallel to the arrow showing the direction of the current equal 12 miles (= 1 × 12). Then g′ will be your position at the end of 12 hrs.

Again, you are at g′ and bound for B, what course would you steer, if the drift of the current for the next 4 hrs. were 1 knot per hour, its set S.W. b. W. ½ W. and your own rate of sailing 6 knots? Set off g′ h S.W. b. W. ½ W. = 4 miles (= 4 × 1 knot). Join g′ B. Take h k = 24 miles (4 × 6 miles), then with h as centre and h k as radius, draw the arc, cutting g′ B in k. Join k h, and through g draw g′ k′ parallel to k h, g′ k′ is the course you must steer, and is W. b. N. ½ N.

Questions.

1. Bound from S′ to B, fair wind, running 8 knots an hour, met a S.S.E. current of 1½ knots per hour, what course should I steer? *Ans.* N.E. b. E. ½ E.

2. In question 1 wind veered to N.N.W., so that ship made 1 point leeway, what course ought I then to steer? *Ans.* N.E. ½ E.

3. On the 11th of February, 1884, sailed from C for T at 11 A.M., how would the tidal stream be? *Ans.*—It would be ebb and with the ship.

4. On the 16th of February, 1884, how much water will there be in addition to the soundings over the bar at the entrance to A at 2 P.M.? *Ans.*—Half the difference between spring and neap rise = $\frac{4}{2}$ = 2 + $\frac{2}{3}$ neap rise = 2 + 5 = 7 ft.

5. Steering S.E. off E.′, close hauled on starboard-tack and making 5 knots an hour by the log, and 1 point leeway. Current setting S.S.E., 2 knots, observed at 9 P.M. light to bear S. b. E. and again at 11 P.M. to bear S.W. ½ W. How far is the ship from the light at 11 P.M.? *Ans.* 9 miles.

CHAPTER V.

SIGNS ON THE CHART, SOUNDING, AND LOG OF A VOYAGE.

In preceding chapters I have endeavoured to describe how to find the ship's position by means of the log and compass, and how to shape her course with reference to distance, direction, and currents.

There are still some points to be considered, such as the meaning of the signs and abbreviations on the chart, the nature of the lights and buoys, and, most important of all, the soundings, which show the depth of water.

At the end of this book you will find explanations, in a tabular form, of the various signs, &c., adopted in charts issued by the Admiralty; other charts are founded upon the Admiralty charts, and a similar system of signs is used.

Lights.—With regard to lights, you should carefully note the description of each given on the chart, whether it is F. (Fixed) or Rev. (Revolving); if it is Rev. or Fl. (Flashing), in how many seconds the revolution or flash occurs, the colour of the light, and so on; for, by failing to observe these important distinctions, serious accidents may happen.

Ship's Lights and Fog-Signals.—Thus a vessel at anchor where there was much motion with a riding light up might be mistaken, when close to you, for a Flashing light which you thought to be twenty miles distant; but if you counted the seconds between the flashes, and compared them with the time stated on the chart, such an error could not occur. Harbour lights are usually red. Lights to be carried and fog-signals to be used by steamers, sailing-ships, fishing-boats, &c., under way or at anchor, are given in a tabular form also at p. 51, according to instructions issued by the Board of Trade in 1881.

On foggy coasts at important headlands fog-guns, fog-horns, or fog-whistles have been established, and are of the greatest service in such dangerous localities. As the intervals between the reports of guns fired, or blasts from horns or whistles, is necessarily long, the direction of the point from which the sounds appear to come may be estimated; but this direction will be affected by the wind, and will appear to be more to leeward than is the case. You may perhaps be in a fog yourself, whilst the headland upon which the fog-whistle is established is surrounded by some miles of clear weather and consequently not be in operation, you should not, therefore, place too much reliance upon hearing a fog-gun or fog-whistle, but look upon it rather as a useful help.

Buoys.

It is most important to understand the system of buoys in use where your voyages generally carry you, more particularly as the systems adopted by different countries vary so much. The following notes on buoys are extracted, by the kind permission of the editor, from his most useful little work, "The Sailor's Pocket Book." *

System of Buoyage, in use by the Corporation of Trinity House, in Buoying New Channels.

The side of the channel is to be considered starboard or port, with reference to the *entrance* to any port *from* seaward.

The entrances of channels, or turning-points, shall be marked by conical buoys with or without staff and globe, or triangle, cage, etc.

Single-coloured can-buoys, either black or red, will mark the *starboard* side, and buoys of the same shape and colour, either chequered or vertically striped with white, will mark the *port* side; further distinction will be given, when required, by the use of conical buoys with or without staff and globe or cage, *globes* being on the *starboard* hand and *cages* on the *port* hand.

Where a *middle* ground exists in a channel, each end of it will be marked by a buoy of the colour in use in that channel, but with horizonal rings of white, and with or without staff and diamond, or triangle, as may be desirable; in case of its being of such extent as to require intermediate buoys, they will be coloured as if on the sides of a channel. When required, the outer buoy will be marked by a staff and diamond, and the inner one by a staff and triangle.

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* Fourth Edition, published by J. Griffin & Co., Portsmouth. Price 7s. 6d.

Wrecks will still continue to be marked by green nun-buoys: light vessels or other craft anchored to mark the position of wrecks have their top sides coloured green, and exhibit two balls placed horizontally on a yard by day, and two white fixed lights placed horizontally by night.

All light ships and buoys have their names painted on them in conspicuous letters.

In the River Mersey.

Can-Buoys.—Red on the starboard hand when running in.

Nun-Buoys.—Black on the port hand when running in.

Buoys with perch and ball indicate elbows or turning points in channels. Each buoy bears the initial letter of the name of the channel it occupies, with a number, according to its situation reckoned from seaward, in the channel thus: Q indicates the outer buoy of the Queen's channel.

British India.

A uniform system of buoyage is being gradually introduced: it is as follows:—

The side of the channel is to be considered starboard or port, with reference to the *entrance* to any port *from* seaward.

The entrances of channels or turning points are marked by *conical* buoys, with a staff carrying globe, or triangle, or basket; *black* buoys on starboard side of the channel, and *red* on port hand.

The sides of channels are marked by *conical* buoys, painted *black* on the *starboard* side, and *can* buoys painted *red* on the *port* side.

Middle grounds are marked by *conical* buoys showing *red* on one side of the buoy, *black* on the other, surmounted by a *double* beacon, either of basket and globe or basket and triangle.

Wrecks are marked by *green nun*-buoys.

Fairway buoys are *conical* and painted *chequered black* and *white.*

Isolated sunken rocks are marked by *red conical buoys.*

Canada

Is buoyed on the same system as the United States of America. See *page 42.*

China.

The side of the channel is to be considered starboard or port, with reference to the *entrance* to any port *from* seaward.

Buoys coloured *red* mark the *starboard* side of the channel; buoys coloured *black*, the *port* side.

Buoys painted in *red and black horizontal bands* mark the fairway, and should be passed close to.

Buoys painted in *red and black vertical* stripes mark the ends of spits, and the outer and inner extremes of banks, shoals, or extensive reefs, when there is a navigable channel on either side.

Buoys painted *red and black chequered* mark rocks, or obstructions of small extent, having channels on either side of them. When marking the latter, they will be placed to seaward of the danger.

When two *chequered* buoys—*red and white* and *black and white*—mark an obstruction, the *red and white* buoy marks the *starboard* side of the channel; and the *black and white* buoy marks the *port* side.

Wrecks are marked by green buoys.

Beacons are painted in the same manner as buoys.

Denmark.

The following are the regulations for buoyage in this country:—

In coming from the *north* or from the *east*, or in entering into a closed bay, buoys with *red* or *black* poles are on the *starboard* hand, and buoys with *white* poles on the *port* hand.

In coming from the *south* and from the *west*, white poles to starboard and red or black to port.

A pole with stripes of different colours indicates a middle ground.

Buoys are also used with poles to which is attached a *broom*, the broom being turned *downwards* on the east side of a channel, and *upwards* on the west side.

Wrecks are marked by casks or buoys painted green and surmounted by a green flag.

France.

Shipmasters frequenting the ports and harbours on the coast of France must observe the following rules:—

On entering a channel from seaward, all buoys and beacons painted *red* with a *white* band near the summit, must be left to starboard; those painted *black* must be left to port. Buoys that can be passed on either side are coloured *red with black horizontal bands.* That part of the beacon *below the level of high water,* and all warping buoys, are coloured *white.* The small rocky heads in frequented channels are coloured in the same way as the beacons, when they have a surface sufficiently conspicuous.

Each beacon or buoy has upon it, either at full length or abbreviated, the name of the danger it is meant to distinguish; likewise its number, commencing from seaward, and thus showing its numerical order in the same channel.

The *even* numbers are on the *red* buoys, and the *odd* numbers on the *black* buoys; the buoys and beacons coloured *red with black horizontal bands* are named but not numbered.

The letters and numbers are painted in *white* on the most prominent part of the buoys, and are from ten to twelve inches in length.

The masts of the beacons which do not present sufficient surface are surmounted for this purpose by a small board. All the jetty heads and turrets are coloured above the half-tide level, and on the former a scale of metres is marked, commencing from the same level.

Tide Signals.—In French ports, flood and ebb, and the height of the tide, are signalled at intervals by means of black balls and by flags; these are hoisted on a mast crossed by a yard.

A ball at the intersection of the mast and yard indicates a depth of 3 metres or 9¾ feet. Each ball *below* this, and in the line of the mast, represents an additional height of 1 metre or 3¼ feet,—but each ball *above* it, an additional height of 2 metres, or 6½ feet. A ball hoisted at the yard-arm, and seen to the left of the mast indicates ·25 metres, or ¾ of a foot additional; but seen to the right of the mast, ·5 metres, or 1⅔ feet additional.

In order to show the state of the tide in respect to flood and ebb, a white flag crossed with black from corner to corner and a black pendant will be used. *One or both* of these will be flying at the masthead, so long as there are

2 metres, or 6½ feet, of water in the channel: thus, the pendant above the flag indicates flood; the flag alone, high water; and the pendant below the flag, ebb.

A *red* flag at the masthead indicates that the state of the tide is such that a vessel *cannot* enter.

Netherlands.

The rule is: on entering the channel, &c., from seaward, *white* buoys must be left on the *starboard* hand; *black* buoys on the *port* hand. There are certain exceptions to this rule, as at Groningen, where the colours are reversed.

Outside buoys and those indicating where the division of a channel begins are painted *red.*

Wreck buoys are either painted *green* or *chequered black and white.*

Belgium

Is buoyed on the same system as the Netherlands.

Norway.

A *white* stake with a broom turned upwards denotes that the shoal lies to the north or east of the mark.

A *black* stake with a broom turned downwards denotes that the danger lies to the south or west of the mark.

A stake with *white and black horizontal stripes,* surmounted by a ball, may be passed on either side.

Russia.

The buoyage arrangements in Russia are very similar to those which are in use in Sweden and Norway—that is, the sea marks (which mostly consist of poles surmounted by different signals and varied in colour), denote the compass bearing of the danger which they are intended to mark. The sea-marks are classified as follows :—

For the Open Seas.—1. A *red* broom open *upwards* on a red pole means that the danger lies to the *north.*

2. A *black* broom open *downwards* on a white pole means that the danger lies to the *south.*

3. Two *black* brooms on a black and white chequered pole means that the danger lies to the *east.*

4. Two *red* brooms on a red and white chequered pole means that the danger lies to the *west.*

5. A *black* pole with cross at the top and surmounted by a ball means that a vessel can pass on all sides.

The Finnish Fiords are buoyed on the same principle as above, but some of the marks differ slightly in character.

Sweden.

Sea marks placed south or west of a shoal or danger are coloured *red,* they mostly consist of a pole with a broom at the top. Those placed north or east of a shoal consist of a smooth unpainted pole. A pole with a cross at the top denotes that the shoal can be passed on all sides.

At night, the intermittent light (on Von Otter's system) is used to indicate the sailing channels, one *red* or *white* flash every *four* seconds being used to indicate the *port* side, and *two quick flashes* either *red* or *white* with the same interval of darkness, the *starboard* side.

United States of America.

In approaching the channel, &c., from seaward, *red buoys,* with *even numbers,* must be left on the *starboard* hand in passing in, *black buoys,* with *odd numbers,* on the *port* hand.

Buoys painted with *red* and *black horizontal stripes* will be found on obstructions with channel ways on either side of them, and may be left on either hand in passing in.

Buoys painted with *white* and *black perpendicular stripes* will be found in *mid-channel,* and may be passed close to.

All other distinguishing marks to buoys will be in addition to the foregoing, and may be employed to mark particular spots; a particular description of which will be given in the printed list of buoys.

Perches with balls, cages, &c., will, when placed, be at turning points, the *colour* and *number* indicating on what side they shall be passed.

Vessels approaching or passing Light Vessels of the United States, *in foggy,* *thick weather*, will be warned of their proximity by the alternate ringing of a bell and sounding of a fog-horn on board of the Light Vessel, at intervals not exceeding five minutes.

Soundings.—Soundings, or the depth of water at low water spring tides, are shown on the chart by the numbers marked all over the sea. They are usually given in fathoms, but sometimes in feet, where the depth is small, as in plans of harbours. "Soundings in feet" or "soundings in fathoms," as the case may be, will always be found marked under the title of the Admiralty Chart.

The nature of the bottom is also shown by the letters amongst the soundings, thus "m" means a muddy bottom, &c., as you will see from the Table of abbreviations at p. 53.

The depth of water is ascertained from the ship by means of the Hand Lead Line, or Deep Sea Lead Line which are marked as shown below. Massey's Sounding Machine, Walker's Harpoon Sounding Machine, and Burt's Nipper and Buoy are most useful auxiliaries when sounding in deep water. For the following descriptions I am again indebted to the "Sailor's Pocket Book."

HAND LEAD LINE.

Weight of Lead 7 to 14 lbs..

Marks. Fathoms.	Deeps. Fathoms.
	1
2—A piece of leather with 2 strips	
3—A piece of leather with 3 strips	
	4
5—White	
	6
7—Red	
	8
	9
10—A piece of leather with a hole in it	
	11
	12
13—Blue	
	14
15—White	
	16
17—Red	
	18
	19
20—Two knots	

DEEP SEA LEAD LINE.

Weight of Lead 28 to 30 lbs.

Is from 100 to 200 fathoms long and is marked the same as a handline up to 20 fathoms, then with one knot at 25 fathoms, three knots at 30, one knot at 35, four knots at 40, and so on to 95.

Then at 100 fathoms a piece of bunting, at 105 one knot, at 110 a piece of leather, at 115 one knot, at 120 two knots, and so on as in the first 100 fathoms.

Massey's Sounding Machine.

The register wheels are set at the starting points, the small one at the 10 fathom mark; and the large one on the opposite side at the 150 fathom mark, the catch is then shut down on the fan. On entering the water the catch is lifted and the fan revolves until bottom is reached, when the fan stops and the catch falls on it. It registers the depth in fathoms.

Walker's Harpoon Sounding Machine.

The first wheel marks one revolution in 30 fathoms; and the second one in 150 fathoms.

The dials are set by turning the button on the first dial until the pointer is opposite the number 30, and the index of the wheel on the other side of the machine points to 150.

Burt's Nipper and Buoy

Is a small metal apparatus, similar to a snatch block, attached to a canvas conical bag which acts as a buoy; the line is snatched in the block, the whole forming a sort of floating pulley. As long as the strain of the descending lead is on, the lead line runs freely, at the same time the bag is, to a certain extent, submerged. On the strain being removed, by the lead reaching the bottom, the line is nipped by a spring, and the bag rising to the surface gives notice that the sounding has been obtained, and that the line may be run in; the depth of water being known by the position in which the nipper is found on the lead line.

Use of the Lead.—The use of the lead is the surest way of testing your "Dead Reckoning" (written D. R.), as the position is called in which you reckon by means of log and compass your ship to be.

When your position has been found by observation of heavenly bodies, or objects marked on the chart, it is called "Position by Observation." When you are doubtful about your position turn at once to the lead as your best friend; when entering harbours (however well you know them, for "people often stumble over their own doorstep") always keep the hand-lead going, and the crew will soon find how much trouble it saves all hands in the end.

L. L. L. L. are said to be the sailor's watchword, meaning "Log, Lead, Latitude, Look out," and of these I am sure you will find that the lead is the most to be relied upon. About latitude I have said but very little to you, it is placed amongst the four L's because it is so easily and surely found by observation of the sun or Pole star; when you have mastered the use of the chart for coastal navigation I hope you will go on to learn foreign-going or ocean navigation.

In using the deep-sea lead, remember always to heave from the windward side of the ship.

In order to make some trial of the contents of this book we will take a voyage together in a well-equipped fore and aft schooner of 100 tons, drawing 12 ft. in ballast, starting from the roadstead at D to take in cargo at T, for A harbour. *See* Log of schooner "Brave," p. 48 to 50.

Coasting Log Book.—But to begin with, I don't know of a satisfactory form of log for coasting vessels, and the ordinary form of sea log has never seemed to me well adapted to the very varied circumstances of coasting and harbour life. At sea, for example, the work is done as much as possible at the change of the watches, and the whole round of the 24 hrs. is always occupied; moreover, on a foreign voyage the day is naturally reckoned from noon. In coasting voyages the work is necessarily much less regular; harbours are frequently made, and shore-time employed, &c. Now, too, that patent logs are so much in use a special column seems desirable to note the readings, and it is much for the advantage of the log never to set the pointers, but to let them run on continually, as they will not be loosened by friction of their axes. Errors in reckoning are also less likely to occur, I believe, when the plan here proposed has been adopted and your officers have become accustomed to it.

The "Beaufort Scale of Estimating the Force of Wind," ranging from 0 = a calm, to 12 = a hurricane, has been suggested in the log on account of its convenient brevity.

The heading employed for the following log is for the above reasons suggested for trial as a coasting log; no printing is introduced below the heading, and faint dividing lines are used, so that the remainder of the page below the heading can be employed, if required, for a journal in harbour, &c. Whatever form of log book you adopt you should have a log board, or log slate, ruled on both sides to correspond with it.

Sailing Directions.—We shall of course have provided ourselves with the best sailing directions that we can procure, especially as the coast is new to all hands, and have *made enquiries* if there have been any *changes in or additions to the lights, or buoys,* since the date of the publication of our chart.

Remarks upon the Voyage.—After leaving D the ebb and flood tides have not been allowed for as they would counteract one another. At eight bells, morning and evening (8 A.M. and 8 P.M.), all hands, except the watch on deck, mustered, after trimming sails, &c., in the master's cabin for prayers, a short lesson from God's Word and a hymn, in which all joined very heartily, a special prayer was used when under way, and a prayer of thanksgiving the first time they assembled after arrival in harbour. "Jack" said he liked this, and he believed that seafaring-men were generally religious at heart, for they saw much more than others of "the works of the Lord and His wonders in the deep." Jack also remarked, "The skipper tells us that if we can meet for meals he doesn't see why we can't also meet for prayers."

He told me, too, that they had a capital box of books on board, lent to them by a clergyman of some waterside society, whose name he could not quite remember, and that the captain was very kind in helping them to learn during spare hours. Jack told me, too, how they had a new-fashioned kerosene oil stove on board, only about a foot square, by means of which, in half an hour, they could always get themselves a cup of cocoa at 4 A.M., or after reefing, without "rousing" out the cook. Jack spun me all this yarn when we were *anchored with the kedge* under the land; I thought we were too close in for safety, but he said the "Brave" was a good ship to hold to windward, although she didn't seem so to me on the night of the 27th of February in the Strait!

Off G in the fog we were very careful about the soundings, as the sailing directions told us that it could be rounded with perfect safety by the lead, although the currents were strong and uncertain. [This is not an imaginary case, but is similar to the conditions off Cape Race, and forms a good example of the use of soundings where nothing else can be relied upon].

In the voyage from T to A the necessity of allowing for leeway and currents is exemplified, also the desirability of having a common log on board as well as a patent one.

Now having arrived safely in our port let me say good-bye, reminding you that we must, in all our voyages, do the best we can to help ourselves, leaving the rest to the Great Captain of our salvation, and resting assured that in His own good time He will bring us safely to the haven where we would be.

Questions.

1. What are the four L's a sailor should attend to?

2. What do the two white bunting marks on the hand lead line mean?

3. How is the Deep-sea line marked at 100 fathoms, and at 75 fathoms?

4. What do the letters col., y. m., cl., mean when found amongst the soundings?

5. What are the lights an open fishing-boat is to show at night when under way?

6. What is the new rule in the 1881 regulation about lights, when under way, that is applicable to all ships?

7. Caught in a heavy N.W. gale half way between V and B, the rate of the lee currents being 3 knots, the ship finding the sea too heavy to run lies within 7 points of the wind and makes 5 points leeway, her speed by log being 2 knots, on which tack would you keep her? Where would you be at the end of 24 hrs. by D. R.? What would be the result of heaving to, first on one tack and then on the other? *Ans.*—She should heave to on the starboard tack and try to get under the land at F. Upon the port tack she would probably be driven ashore near C, and would certainly go ashore if she hove to for 12 hrs. on the port tack and then wore to starboard tack.

LOG OF THE SCHOONER "BRAVE," 100 TONS REGISTER, FROM D TOWARDS T.

<table>
<tr><th colspan="3">Date. 1884.</th><th colspan="2">DISTANCE.</th><th rowspan="2">Course.</th><th rowspan="2">Direction and Force (0 to 12) of Wind.</th><th rowspan="2">REMARKS.</th></tr>
<tr><th>Month.</th><th>Day.</th><th>Hour.</th><th>Noted on Patent Log.</th><th>Miles run.</th></tr>
<tr><td colspan="8"><i>Feb.</i> 18 at 9 p.m. <i>Mon.</i>—Lying at single anchor in D roads, in ballast, ready for sea. Received a telegram to proceed to T, and ship a general cargo there for Messrs. Tomkins of A. Calm. Bar. 30·10. At 9·30 p.m. ebb tide still running, ship's head S.E. Pole Star bore N. b. E. ½ E., and again at 11·30 p m., flood tide having made, ship's head N.W. b W. Pole Star bore N. b. E. ¾ E., which agree with 19° westerly variation given on chart. New Moon on the 26th Feb. afternoon.</td></tr>
<tr><td colspan="8"><i>Feb.</i> 19, <i>Tues.</i>—4 a.m., light air from N.W. Weighed anchor and proceeded to sea, all sail set. New moon Feb. 26, therefore H. W. F. and C. being 11·5. H.W. on Feb. 19 about 5 a.m., and there is whole ebb tide before us.</td></tr>
<tr><td><i>Feb.</i> 19</td><td><i>Tues.</i></td><td>5 a.m.</td><td>5·6</td><td>..</td><td>..</td><td>N.W. b.W. 4</td><td>Log overboard at 5 a.m., showing 5·6, off W. end of D Island, dist. ½ m. Tried pumps at 6 a.m.; no water in her.</td></tr>
<tr><td>"</td><td>"</td><td>8 a.m.</td><td>22·1</td><td>16·5</td><td>W. S. W.</td><td>N.W. b. W. 3</td><td>Tacked ship. Bar. 30·20.</td></tr>
<tr><td>"</td><td>"</td><td>3 p.m.</td><td>48·7</td><td>26·6</td><td>N. b. W.</td><td>W.N.W. 4.</td><td>Wind falling, let go kedge anchor in 8 fathoms to stop flood tide.</td></tr>
<tr><td colspan="8">Found position of anchorage by crossbearings, which agrees with D. R., allowing for tide. 6 p.m. Tues. Bar. 20·90. Weather looks unsettled, took a reef in mainsail and staysail and stowed jib. At 7 p.m. wind backed to S.W. 4. 7·30 p.m. weighed kedge anchor and stood off on port tack; side lights in good order, 2 in. water in well.</td></tr>
<tr><td><i>Feb.</i> 19</td><td><i>Tues.</i></td><td>9.30 p.m.</td><td>64·2</td><td>15·5</td><td>W.</td><td>S.S.W. 5</td><td rowspan="2">At midnight Bar. 29·80, foggy, changed course to W.N.W., kept fog horn going, 3 blasts. 2·30 heard steamer's whistle astern, observed her 3 lights, showed flare up light over stern.</td></tr>
<tr><td>"</td><td>"</td><td>12 mdght.</td><td>84·2</td><td>20</td><td>W.N.W.</td><td>S. 6.</td></tr>
<tr><td><i>Feb.</i> 20</td><td><i>Wed.</i></td><td>4 a.m.</td><td>15·2</td><td>31·0</td><td>W.N.W.</td><td>S. b. E 6.</td><td>Allowed 6 m E.N.E. current since midnight. Sounded at 4 a.m. 26 fathoms sand.</td></tr>
<tr><td>"</td><td>"</td><td>5 a.m.</td><td>23</td><td>7·8</td><td>"</td><td>"</td><td>Sounded at 5 a.m. 24 fathoms sand.</td></tr>
<tr><td>"</td><td>"</td><td>5·30 a.m.</td><td>28·0</td><td>5·0</td><td>"</td><td>"</td><td>Sounded at 5·30 a.m. 24 fathoms sand.</td></tr>
<tr><td>"</td><td>"</td><td>6 a.m.</td><td>33·0</td><td>5·0</td><td></td><td>"</td><td>Sounded at 6 a.m. 48 fathoms sh. Allowed an easterly current of 3 m. since 4 a.m. At 6 a.m. gybed ship and steered N. b. E., still foggy.</td></tr>
<tr><td>"</td><td>"</td><td>8 a.m.</td><td>47·5</td><td>14·5</td><td>N. b. E.</td><td>S.S.W. 6.</td><td>At 8 a.m. sounded 45 f. sh. Allowed 2 m. S. b. W. current since 6 a.m.</td></tr>
</table>

LOG OF THE SCHOONER "BRAVE," 100 TONS REGISTER, FROM D TOWARDS T—*continued.*

Date. 1884.			Distance.		Course.	Direction and Force (0 to 12) of Wind.	REMARKS.
Month.	Day.	Hour.	Noted on Patent Log.	Miles run.			
Feb. 20	*Wed.*	12 noon.	71·5	24	N. b. E.	S.W. 5.	Noon, fog cleared off. Allowed 4 m. S. b. W. current since 8 a.m. Saw lighthouse at Q bearing E. b. N., estimated distance 10 m., which makes ship's D. R. 4 m. ahead of her true position. Shook out reefs and set jib.
"	"	4 p.m.	1·5	30	steering by land.	W.N.W. 6.	C harbour bears S.E. b. E., stowed jib. Log shows 4 m. too much, because of flood tide since noon.
"	"	8 p.m.	33·5	32	E. b. N.	N.W. 6.	Fine night.
"	"	12 mdght.	61·5	28	E ½ S.	N.W. 6.	
Feb. 21	*Thur.*	4 a.m.	91·5	30	E. ½ S.	N.N.W. 6.	4 a.m., hove to on port tack, having hauled down foresail; waiting for daylight. H. W. 5·35.

At 6 a.m. dawning bore away for T roads and anchored at 7 a.m. with best bower in 5 fathoms m. Bearings at anchorage—Custom House, S.S.E., Nun Buoy, W.

Feb. 21 *Thur.*—Went ashore at once to C. Ho.; got lighters alongside to discharge ballast. Let go second anchor at 10 a.m. and moored with swivel, 30 fathoms on best bower, 15 fathoms on second.

Feb. 22 *Fri.*—Taking in cargo. Fine weather.

Feb. 23 *Sat.*— do. do. do. do.

Feb. 24 *Sun.*—Crew had leave all day, and went ashore from 9 to 5.

Feb. 25 *Mon.*—Wet day. Mr. Smith, passenger, came on board at 6 p.m. 10·40 p.m., on taking bearing of Pole Star observed compass to show one point easterly deviation. Found that Mr. Smith's chest with carpenter's tools had been stowed on deck close to binnacle; removed chest.

Feb. 26 *Tues.*— Completed loading. Filled up with fresh water and provisions. Cleared. Unmoored ship in afternoon. H. W. about 9 p.m. Wind N.W.; strong ebb tide running; held on until daylight, night being very dark.

Feb. 27 *Wed.*—Weighed anchor at 7 a.m. bound for A harbour. Found compass to be now correct by bearing of two objects in line on shore.

FROM T TOWARDS A HARBOUR.

Month.	Day.	Hour.	Noted on Patent Log.	Miles run.	Course.	Direction and Force (0 to 12) of Wind.	REMARKS.
Feb. 27	*Wed.*	7·30 a.m.	91·5	..	..	N.N.E. 5.	Hove log over off Nun Buoy. Allowed 3 m. E. for ebb tide.
"	"	1·30 p.m.	36·5	45·0	W. ½ N.	0.	Becalmed at 1·30 p.m. Tried pumps.
"	"	4 p.m.	36·5	..	N.W. b. N.	W.S.W. 4.	Allowed 4 m. ebb tide, E. b. N. Stowed jib and made all snug for the night. 10·30 observed a large ship on lee bow, close hauled on starboard tack, kept away to let her pass ahead.

LOG OF THE SCHOONER "BRAVE," 100 TONS REGISTER, FROM T TOWARDS A—*continued.*

Date. 1884.			DISTANCE.		Course.	Direction and Force (0 to 12) of Wind.	REMARKS.
Month.	Day.	Hour.	Noted on Patent Log.	Miles run.			
Feb. 27	*Wed.*	12 mdght.	68·8	32·3	N.N.W.	W.S.W. 5.	Bar. 29·50. Standing well off shore to take advantage of Strait current. Allowed 6 m. up to midnight W.S.W. for Strait current and flood tide. At midnight wind suddenly backed to S.W. in a sharp squall. Reefing all middle watch until under double-reefed fore-sail at 4 a.m.
Feb. 28	*Thur.*	4 a.m.	74·7	5·9	N.W.	S.W. 9.	Leeway 3 points. Pumped ship every hour.
"	"	12 noon.	82·9	8·2	W.N.W.	S.S.W. 9.	Gale continuing. Rough cross sea. Bar. 29·40. Leeway 3 points.
"	"	3 p.m.	92·7	9·8	W. b. N.	S.S.W. 7.	2 points leeway. Set 2 reefed mainsail and staysail without bonnet.
"	"	4 p.m.	97·8	5·1	S. W. b. S.	S.E. 5.	1 point leeway. Since midnight allow 16 m. S.W. b. W. ½ W. current. Bar. 29·30, stationary.
"	"	8 p.m.	·8	2·3	S.W.	N.E. 3.	4 m. current S.W.b.W. ½ W. allowed. By D. R., F light bears S.W. 132 m.
"	"	midnight.	24·1	24·0	S.W.	N.E. 5.	Midnight. Bar. 29·40, rising rapidly. 4 m. current.
Feb. 29	*Fri.*	4 a. m.	60·1	36·0	"	N.E. 7.	4 m. S.W. current. Allowing ship about 10 m. per hr., and S. current 2 m. per hr., found course to steer for F to be S.W. ½ W. At 5·30 a.m. lost patent log, line seemed bitten close to log.
"	"	6 a.m.	by common log.	9·9	S.W. ½ W.	N.N.E. 8.	Got ready common log at once.
"	"	7 a.m.	..	10·1	"	"	
"	"	8 a.m.	..	10·1	"	"	At 8 a.m. sighted F headland bearing S.W.b.W.
"	"	9 a.m.	..	10·0	"	"	
"	"	10·30 a.m.	..	..	..	..	1 m. off F, from which reckoning backwards position on chart was shown at 8 a.m., or D. R. was 8 m. too far to westward; Strait current was probably retarded by south-westerly gale. H. W. at A to-day at about 2·15 p.m.
"	"	noon.	..	..	..	..	Let go port bower anchor off Messrs. Tomkins' wharf at noon, and hauled alongside. Telegraphed arrival to owners.

LIGHTS TO BE CARRIED BY SHIPS AND BOATS, AND FOG SIGNALS TO BE USED.

Description of Ship or Boat.	Lights to be carried and Fog Signals to be used.
No. 1.—Steamer under way	A bright white masthead light, at least 20 feet above the hull, to throw the light from right ahead to 2 points abaft the beam on either side, and to be visible 5 miles in clear weather; also a green light on the starboard side, and a red light on the port side, each of these lights to show from right ahead to 2 points abaft the beam, and to be visible 2 miles in clear weather. These lights shall be provided with inboard screens projecting at least 3 ft. forward from the light, so as to prevent either light from being seen across the bow. } Termed Side Lights *During fog.*—A prolonged blast from her steam whistle at intervals not greater than 2 minutes.
No. 2.—Steamer under way and towing.	In addition to the above described in No. 1, a second bright white masthead light, similar to the first one ordered, and placed vertically 3 ft. beneath it.
No. 3.—Ship being towed.	Side lights only.
No. 4.—Sailing ship.	Side lights only, precisely similar to those ordered for a steamer. *See* No. 1. *During fog, mist or falling snow* she shall make with her fog-horn, at intervals of not more than 2 minutes— when on the starboard tack, one blast, „ „ port „ two blasts in succession, „ with the wind abaft the beam three blasts in succession.
No. 5.—Steamer or sailing ship, when at anchor.	A globular lantern, not less than 8 in. in diameter, to show all round the horizon and be visible 1 mile, placed where it can best be seen, and not more than 20 ft. above the hull. *In fog.*—Ring the bell at not less than 2 min. intervals.
No. 6.—Steamer or sailing ship, not under command.	*At night.*—Three red lights in globular lanterns, 10 in. in diameter, in a vertical line, one over the other, not less than 3 ft. apart, where a steamer's masthead light is carried. *In daytime.*—Three black balls, each 2 ft. in diameter in a vertical line, 3 ft. apart in front of but not lower than her foremast head.
When laying a telegraph cable, or disabled.	Three lights in globular lanterns, each not less than 10 inches in diameter, in a vertical line over one another, not less than 6 feet apart; the highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of

LIGHTS TO BE CARRIED BY SHIPS AND BOATS, AND FOG SIGNALS TO BE USED.—*continued.*

Description of Ship or Boat.	Lights to be carried and Fog Signals to be used.
No. 6.—When laying a telegraph cable, or disabled—*cont.*	such a character that the red lights shall be visible at the same distance as the white light. By day she shall carry in a vertical line one over the other not less than 6 feet apart, in front of but not lower than her foremast head, three shapes not less than 2 feet in diameter, of which the top and bottom shall be globular in shape and red in colour, and the middle one diamond in shape and white. N.B.—The ships referred to in this Article, when not making any way through the water, shall not carry the side lights but when making way shall carry them.
No. 7.—Pilot vessels, when engaged on their stations.	Only a white light at her masthead, visible all round the horizon, and flare-ups at 15 min. intervals. N.B.—A pilot vessel, when not engaged on her station on pilotage duty, shall carry lights similar to those of other ships.
No. 8.—Open fishing boats and other open boats.	Open boats and fishing vessels of less than 20 tons net registered tonnage, when under way, and when not having their nets, trawls, dredges or lines in the water, shall not be obliged to carry the coloured side lights; but every such boat shall in lieu thereof have ready at hand a lantern with a green glass on the one side and a red glass on the other side; and on approaching to or being approached by another vessel, such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.
No. 9.—Fishing vessels and open boats, if in the sea off the coast of Europe lying North of Cape Finisterre; when at anchor and attached to nets and stationary.	All fishing vessels and fishing boats of 20 tons net registered tonnage, or upwards, when under way and when not required by the following regulations to carry and show the lights therein named, shall carry and show the same lights as other vessels under way. All vessels when engaged in fishing with drift nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights shall be placed so that the vertical distance between them shall be not less than 6 feet and not more than 10 feet; and so that the horizontal distance between them measured in a line with the keel of the vessel shall not be less than 5 and not more than 10 feet. The lower of these two lights shall be the more forward, and both of them shall be of such a character, and contained in lanterns of such construction as to show all round the horizon, on a dark night with a clear atmosphere, for a distance of not less than 3 miles. A vessel employed in line fishing, with her lines out, shall carry the same lights as a vessel when engaged in fishing with drift nets. If a vessel when fishing becomes stationary in consequence of

LIGHTS TO BE CARRIED BY SHIPS AND BOATS, AND FOG SIGNALS TO BE USED—*continued.*

Description of Ship or Boat.	Lights to be carried and Fog Signals to be used.
No. 9.—*continued.*	her gear getting fast to a rock or other obstruction, she shall show the light and make the fog signal for a vessel at anchor. Fishing vessels and open boats may at any time use a flare-up in addition to the lights which they are by this Article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag net shall be shown at the after part of the vessel, excepting that, if the vessel is hanging by the stern to her trawl, dredge, or drag net, they shall be exhibited from the bow. Every fishing vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light visible all round the horizon at a distance of at least 1 mile. In fog, mist, or falling snow, a drift-net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag net, and a vessel employed in line fishing with her lines out, shall at intervals of not more than 2 minutes make a blast with her fog-horn and ring her bell alternately.
No. 10.—Ships being overtaken.	A white light or flare-up shown from her stern to the overtaking ship.

Explanation of Signs and Abbreviations adopted in the Charts issued by the Hydrographic Office, Admiralty.

Quality of the bottom.	
b.	— blue
blk.	— black
br.	— brown
brk.	— broken
c.	— coarse
cl.	— clay
crl.	— coral
d.	— dark
f.	— fine
g.	— gravel
gn.	— green
grd.	— ground
gy.	— gray
h.	— hard
m.	— mud
oys.	— oysters
oz.	— ooze
peb.	— pebbles
r.	— rock
rot.	— rotten
s.	— sand
sft.	— soft
sh.	— shells
spk.	— speckled
st.	— stones
stf.	— stiff.
w.	— white
wd.	— weed
y.	— yellow

General Abbreviations.	
Alt. (*near a light*)	Alternating
Anch^{ge}.	— Anchorage
B.	— Bay
B. (*near a buoy*)	Black
Bat^{y}.	— Battery
B^{k}.	— Bank
C.	— Cape
C. G.	— Coast Guard
Cath.	— Cathedral
Ch.	— Church
Chan.	— Channel
Cheq. (*near a buoy*)	Chequered
Col^{d}.	— Coloured
Cr.	— Creek
E. D.	— Existence Doubtful
Flg. Lt.	— Floating Light
Fms.	— Fathoms
Ft.	— Feet or foot
G.	— Gulf
Gt.	— Great
H.	— Hour
Hd.	— Head
Ho.	— House
H^{r}.	— Harbour
H. S. (*near a buoy*)	Horizontal Stripes
H. W.	— High Water
H. W. F. & C.	High Water Full and Change
I.	— Island
I^{s}.	— Islands
Kn.	— Knots
L.	— Lake
Lat.	— Latitude
Long.	— Longitude

General Abbreviations.	
Lt.	— Light
Lt. F.	— Light Fixed
Lt. Fl.	— Light Flashing
Lt. Int.	— Light Intermittent
Lt. Rev.	— Light Revolving
Lt. Occ.	— Light Occulting
Lt. Alt.	— Light Alternating
L. W.	— Low Water
Magz.	— Magazine
Magc.	— Magnetic
Min. (*near a light*)	Minutes
Mt.	— Mountain
Np.	— Neaps
Obsn. Spot	— Observation Spot +
P.	— Port
P. D.	— Position Doubtful
Pk.	— Peak
Pt.	— Point
R.	— River
R. (*near a buoy*)	Red
Rf.	— Reef
Rk.	— Rock
Sd.	— Sound
Sec. (*near a light*)	Seconds
Sh.	— Shoal
Sp.	— Springs
Str.	— Strait
Tel.	— Telegraph
Varn.	— Variation
Vil.	— Village
Vis. (*near a light*)	Visible
V. S.	— Vertical Stripes
W. (*near a buoy*)	White
W. Pl.	— Watering Place
Occ. (*near a light*)	Occulting

GENERAL REMARKS.

All Charts and Plans are, where practicable, constructed upon the True Meridian, *i.e.*, the East and West marginal lines are drawn parallel to the True Meridian.

Soundings are reduced to mean Low Water of ordinary Spring tides, and are expressed in Fathoms (of 6 feet) and fractions of a fathom, or in feet and fractions of a foot, such being denoted on the title of the Chart.

Expla

Quality

b.
blk.
br.
brk.
c.
cl.
crl.
d.
f.
g.
gn.
grd.
gy.
h.
m.
oys.
oz.
peb.
r.
rot.
s.
sft.
sh.
spk.
st.
stf.
w.
wd.
y.

Ea

Fa
de

The underlined figures on the dry banks represent in feet or fathoms the depth of water over em at High Water, or the heights of the banks above Low Water. The method adopted is xplained in the Title of the Chart.

The *Velocity* of Tide is expressed in knots and fractions of a knot. The *Period* of the Tide eing shown thus 1st *Qr.*, 2nd *Qr.*, 3rd *Qr.*, 4th *Qr.*, for 1st, 2nd, 3rd, and 4th Quarters.

The *Rise* of Tide is measured from the mean Low Water level of Ordinary Springs. The *ange* of Tide is measured from the Low Water of one tide to the High Water of the following de.

All heights are given in feet above High Water Ordinary Springs, and in places where there no tide, above the level of the sea.

All bearings, including the direction of winds and currents, are Magnetic; except when therwise expressed. Bearings of Lights are given as seen from seaward, and not from the lights.

The natural Scale, or the proportion which the Chart bears to the earth, (obtained by educing the number of feet in the minute of latitude to inches, and dividing the product by the umber of inches to a mile the chart is drawn upon,) is represented thus $\frac{1}{12150}$.

A Cable's length is assumed to be the 10th part of a Sea mile, or equal to 100 fathoms.

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